NASA CR 114522
Aerotherm Report No. 72-56, Vol. II

THERMAL SCREENING OF SHUTTLE ORBITER VEHICLE TPS MATERIALS UNDER CONVECTIVE HEATING CONDITIONS

Volume II

Tabulation of Test Results

by

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August, 1973

Contract NAS2-6445

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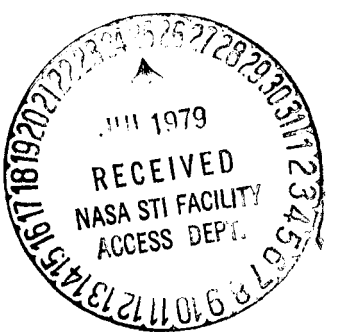

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FOREWORD

This report is Volume II of a two volume report prepared by the Aerotherm Division of Acurex Corporation under National Aeronautics and Space Adminstration Contract No. NAS2-6445 which describes an extensive screening test program under convective heating conditions for the complete spectrum of candidate shuttle orbiter vehicle TPS materials. Volume I serves as the final report under the contract and also presents representative test results. Volume II (this report) is a complete tabulation of all test results on all test samples. This work was sponsored by the Ames Research Center with Mr. Nick S. Vojvodich as the NASA Technical Monitor. The Aerotherm Program Manager and principal investigator was Mr. John W. Schaefer. The author gratefully acknowledges the support of the Technical Monitor and the Aerotherm personnel who contributed to the program.

TABULATION OF TEST RESULTS

A complete tabulation of test results on all test samples of all materials is presented in this appendix. This tabulation includes the following:

Table 1 - Test Sample Description

Table 2 - Sample Test Conditions

Table 3 - Test Sample Response

Table 4 - Test Sample Performance Summary

Table 5 - Test Sample Surface Catalycity Results

The information presented in these tables is described below according to each set of data presented. Comments are also included where appropriate.

Table 1 - Test Sample Description

This table provides the available description of samples tested in order of increasing sample number. Additional details are available from NASA Ames* and/or the supplier. The table headings are described below.

Aerotherm Sample Number - primary numbers used for test sample identification.

Material Description - available description of the materials from which the test samples were made.

Sample Description - test sample configuration.

Supplier - source of the test samples or test sample materials supplied to NASA Ames for the test program.

Supplier Identification - sample number (if any) assigned by the supplier.

NASA Ames Reference - date the test samples were provided to Aerotherm; key to additional data available at NASA Ames and/or the supplier.

*Nick S. Vojvodich, 415 965-6108

Comments	- additional descriptive information where appropriate

Table 2 - Sample Test Conditions

This table provides the complete test conditions to which the test samples were exposed. Data are presented as average conditions for each test which typically covered 6 cycles. No siginficant deviations from the reported conditions were experienced during any test. The table headings are described below.

Test	- test number identification.
Test Condition	- basic test condition at which the test was run; see Section 3.1.*
Model	- model numbers used which also corresponds to the model sting position.
Sample	- Aerotherm test sample number.
Sample Description	- material type, configuration, and supplier identification where available.
Cycle	- last cycle to which the sample was exposed.
Current	- arc heater operating current.
Centerline Total Enthalpy	- heat flux enthalpy; see Sections 2.3.2 and 3.1.
Average Total Enthalpy	- energy balance and mass balance enthalpies; see Section 2.3.3.
Chamber Pressure	- nozzle plenum pressure.
Air Flow Rate	- total air flow rate.
Heat Flux	- cold wall convective heat flux as measured by the calibration model prior to the test and the centerpost calorimeter of the test sample model; in the former case the small number to the right of the heat flux value is the arc heater current corresponding to the heat flux value; see Sections 2.3.2 and 3.3.
Centerpost Stagnation Pressure	- pressure measured at the centerpost of the test sample model.
Comments	- additional information where appropriate.

*All section numbers refer to Volume I.

Note that data in parenthesis indicates that the accuracy is questionable. A malfunction of the data acquisition system for Tests 1959 through 1969 resulted in a scrambled data tape. The dump of this tape was read by hand and in many cases the channel identification and corresponding data value were subject to question. The series of questionable and missing data for this tests is due to this problem.

Table 3 - Test Sample Response

This table provides the complete description of the test sample response. Data are presented for each test which typically covered 6 cycles; values are averages over the test except as noted below. The table headings are described below.

Test
Test Condition
Model
Sample
Sample Description
Cycle

See above for Table 2

Cumulative Exposure Time - total exposure time for the test sample as of the end of the test.

Heat Flux - cold wall convective heat flux to which the the test sample was exposed.

Stagnation Pressure - stagnation pressure to which the sample was exposed.

Total Enthalpy - heat flux enthalpy; see above for Table 2.

Heat Transfer Coefficient - cold wall heat tranfer coefficient, q_{cw}/h_o.

Surface Temperature - as described below; designation in title block or in table body identifies primary pyrometer.

Value - average value (60° samples), or for first or single entry, average value at the pyrometer viewing location that is hotter (120° samples) or hottest (180° and 360° samples), and for second entry where available, average value over entire sample.

Range	- the maximum range of temperatures over the complete test period (e.g., 6 cycles) and where appropriate over the multiple viewing locations on the sample.
Assumed Emissivity	- emissivity values corresponding to the measured temperatures.
Backwall or Midplane Temperature	- thermocouple measurements; backwall for metallics, carbon-carbon composites, and ablators, and midplane for surface insulators.
Apparent Emissivity	- emissivity referenced to the TD-7 pyrometer (1.6 to 2.7 microns) assuming the thermogage and TD-9 pyrometers provide correct readings at the assumed emissivity.
Mass Loss	- mass loss since the last test on the test sample.
Dimension Change	- surface recession (positive number, referenced to the backwall) since the last test on the test sample.
Comments	- additional information where appropriate.

The comments relative to questionable data in Table 2 also apply here.

Table 4 - Test Sample Performance Summary

This table provides a supplement to the 35mm color slides in defining the performance characteristics and failure modes. Results are presented for all samples in the order in which testing was started on the samples. The table headings are described below.

Test	- test number identification of the last test performed on the sample.
Test Condition Model Sample Sample Description	See above for Table 2
End Cycle	- final cycle to which the sample was exposed.
Total Exposure Time	- total time the sample was exposed to the indicated test conditions.

Sample Response and Performance Characteristics - significant information related to sample response and performance

Table 5 - Test Sample Surface Catalycity Results

This table presents the test results on HCF in which heat flux was varied during a single cycle to obtain sets of surface catalycity results. The test conditions are presented in the identical format of Table 2. The test sample response is presented in a format similar to Table 3. The new headings in this latter table are described below.

Hot Wall Heat Flux - heat flux based on the measured cold wall heat flux but corrected for hot wall conditions based on the measured surface temperature.

Radiation Equilibrium Temperature for q_{hw} - surface temperature which would have been achieved under radiation equilibrium conditions for the hot wall heat flux and a fully catalytic surface.

Radiation Equilibrium Heat Flux for T_w - net heat flux to the surface under radiation equilibrium conditions for the measured surface temperature.

Heat Flux Ratio q_{re}/q_{hw} - surface catalycity ratio; see Section 4.2.2.

TABLE 1

TEST SAMPLE DESCRIPTION

Aerotherm Sample Number	Material Description	Sample Description	Supplier	Supplier Identification	NASA/Ames Reference	Comments
1	TDNiCr, Preconditioned Surface	60°	NASA/Langley	A1	6-10-71	
2				B1		
3				C1		
5				B2		
6				C2		
7				A3		
8				B3		
9				C3		
10				A4		
11				B4		
12				C4		
13				A5		
14				B5		
15				C5		
16				A6		
17				B6		
18				C6		
19				A7		
20				B7		
21				C7		
22				A8		
23				B8		
24				C8		
25				A9		
26				B9		
27				C9		
28				A10		
37	Carbon-Carbon Composite	360° Truss Core	Convair	C4A-1	10-28-71	
38				C4A-2		
39				C4A-3		
40				E4A-5		
45		180° Truss Core		PF-C-1		
46				PF-C-2		
47				PF-D-1		
48				PF-D-2		
49				E4A-1-1		
51				E4A-2-1		
55				E4A-4-1		
56				E4A-4-2		
58		60°		DH-1		
59				DH-3		
62				EMI-1		
65	Cb-752 Columbium/R512E Coating		NASA-Lewis	A1	11-4-71	
66				B1		
67	FS-85 Columbium/R512E Coating			A2		
68				B2		
69	C129Y Columbium/R512E Coating			A3		
70				B3		

TABLE 1 (Continued)

TEST SAMPLE DESCRIPTION

Aerotherm Sample Number	Material Description	Sample Description	Supplier	Supplier Identification	NASA/Ames Reference	Comments
71	Coated Tantalum	60°	NASA-Lewis/Solar	N4	11-4-71	
72				M4		
73				C4		
74			NASA-Lewis/LMSC	C5		
75	Cb-752 Columbium/R512E Coating		NASA-Lewis	C1		
76	FS-85 Columbium/			C2		
77	C129Y Columbium/			C3		
78	Cb-752 Columbium/			E1		
79	FS-85 Columbium/			E2		Hole Defect
80	C129Y Columbium/			E3		
81	Cb-752 Columbium/			G1		Removal Defect
82	FS-85 Columbium/			G2		
83	C129Y Columbium/			G3		
84	Cb-752 Columbium/			I1		Notch Defect
85	FS-85 Columbium/			I2		
86	C129Y Columbium/			I3		
87	Cb-752 Columbium/			K1		Impression Defect
88	FS-85 Columbium/			K2		
89	C129Y Columbium/			K3		
90	Cb-752 Columbium/			D1		Hole Defect
91	FS-85 Columbium/			D2		
92	C129Y Columbium/			D3		
93	Cb-752 Columbium/			F1		Removal Defect
94	FS-85 Columbium/			F2		
95	C129Y Columbium/			F3		
96	Cb-752 Columbium/			H1		Notch Defect
97	FS-85 Columbium/			H2		
98	C129Y Columbium/			H3		
99	Cb-752 Columbium/			J1		Impression Defect
100	FS-85 Columbium/			J2		
101	C129Y Columbium/			J3		
102	Cb-752 Columbium/			L1		
103	FS-85 Columbium/			L2		
104	C129Y Columbium/			L3		
105	Coated Tantalum		NASA-Lewis/Solar	A4		
106			/LMSC	A5		
107			/Solar	B4		
108			/LMSC	B5		
109			/Solar	D4		Hole Defect
110			/LMSC	D5		
111			/Solar	E4		
112			/LMSC	E5		
113			/Solar	F4		Removal Defect
114			/LMSC	F5		
115			/Solar	G4		
116			/LMSC	G5		
117			/Solar	H4		Notch Defect

TABLE 1 (Continued)

TEST SAMPLE DESCRIPTION

Aerotherm Sample Number	Material Description	Sample Description	Supplier	Supplier Identification	NASA/Ames Reference	Comments
118	Coated Tantalum	60°	NASA-Lewis/LMSC	H5	11-4-71	Notch Defect
119			/Solar	I4		
120			/LMSC	I5		
121			/Solar	J4		Impression Defect
122			/LMSC	J5		
123			/Solar	K4		
124			/LMSC	K5		
125			/Solar	L4		
126			/LMSC	L5		
127	LI-1500	180°	LMSC		11-18-71	
128						
129						
130						
132	Silicon Carbide Foam				8-24-71	
134						
135						
136	HFC		NASA-MSC/MDAC		6-1-71	
137						
138						
139	LI-1500		NASA-MSC/LMSC			
140						
141						
142						
143						
144						
145	HFC		NASA-MSC/MDAC			
146	LI-1500		NASA-MSC/LMSC			
147	HCF		MDAC		12-21	
148						
149						
150						
151						
152						
153	REI	120°	GE		12-9-71	
154	HCF		MDAC			
155	LI-1500		LMSC			
156	REI		GE			
157	HCF		MDAC			
158	LI-1500		LMSC			
159	SS41 Ablator	360°	NASA-Langley		10-14-71	
160						
161						
162						
163						
164						
165						
166						
167	Carbon-Carbon Composite	180° Truss Core	Convair	E4A-3-1	10-28-71	
168				E4A-3-2		

TABLE 1 (Concluded)

TEST SAMPLE DESCRIPTION

Aerotherm Sample Number	Material Description	Sample Description	Supplier	Supplier Identification	NASA/Ames Reference	Comments
169	Carbon-Carbon Composite	180° Truss Core	Convair	PF-B-1	10-28-71	
170				PF-B-2		
172		60°		DA .05		
174				E-1		
175				DIH-5		
176				DIA 1.5-1		
177				DA 1.5		
178				4H7		
179				5H8		
180				E2		

TABLE 2 SAMPLE TEST CONDITIONS
METALLICS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Current (Amps)	Centerline Total Enthalpy HF (Btu/lb)	Average Total Enthalpy EB (Btu/lb)	Average Total Enthalpy MB (Btu/lb)	Chamber Pressure (atm)	Air Flow Rate (lb/sec)	Heat Flux Calibration Model (Btu/ft²sec)	Heat Flux Center Post (Btu/ft²sec)	Center Post Stagnation Pressure (atm)	Comments
1943	6	2	1	TDNiCr 60° A1	6	210	3500	2110	1920	.177	.0134	13.0 219	12.5	.0057	
			2	B1											
			3	C1											
			28	A10											
			5	B2											
			6	C2											
1943	7	4	10	TDNiCr 60° A4	6	260	5150	2650	2430	.162	.0107	21.3 304	17.7	.0057	
			11	B4											
			12	C4											
			13	A5											
			14	B5											
			15	C5											
1944	6	2	7	TDNiCr 60° A3	6	200	3340	2000	1810	.173	.0134	13.7 232	11.9	.0056	
			8	B3											
			9	C3											
			28	A10	12										
			5	B2											
			6	C2											
1944	7	4	16	TDNiCr 60° A6	6	250	4950	2740	2650	.160	.0107	22.3 306	18.4	.0056	
			17	B6											
			18	C6											
			13	A5	12										
			14	B5											
			15	C5											
1945	6	2	7	TDNiCr 60° A3	12	205	3430	1970	1950	.178	.0134	13.8 221	12.4	.0056	
			8	B3											
			9	C3											
			28	A10	18										
			5	B2											
			6	C2											

TABLE 2 SAMPLE TEST CONDITIONS (Continued)
METALLICS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Current (Amps)	Centerline Total Enthalpy HF (Btu/lb)	Average Total Enthalpy EB (Btu/lb)	Average Total Enthalpy MB (Btu/lb)	Chamber Pressure (atm)	Air Flow Rate (lb/sec)	Heat Flux Calibration Model (Btu/ft²sec)	Heat Flux Center Post (Btu/ft²sec)	Center Post Stagnation Pressure (atm)	Comments
1945	7	4	16	TDNiCr 60° A6	12	270	5350	2590	2780	.166	.0107	22.6 304	19.6	.0057	
			17	B6											
			18	C6											
			13	A5	18										
			14	B5											
			15	C5											
1946	6	2	7	TDNiCr 60° A3	18	203	3390	1950	1900	.176	.0134	13.4 221	12.5	.0056	
			8	B3											
			9	C3											
			28	A10	24										
			5	B2											
			6	C2											
1946	7	4	16	TDNiCr 60° A6	18	250	4950	2610	2650	.160	.0107	21.5 304	18.6	.0056	
			17	B6											
			18	C6											
			13	A5	24										
			14	B5											
			15	C5											
1947	6	2	7	TDNiCr 60° A3	24	197	3290	1970	1890	.175	.0134	13.8 225	12.4	.0056	
			8	B3											
			9	C3											
			28	A10	30										
			5	B2											
			6	C2											
1947	7	4	16	TDNiCr 60° A6	24	242	4800	2490	2780	.163	.0107	22.4 307	(16.8)	.0056	
			17	B6											
			18	C6											
			13	A5	30										
			14	B5											
			15	C5											

TABLE 2 SAMPLE TEST CONDITIONS (Continued)
METALLICS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Current (Amps)	Centerline Total Enthalpy HF (Btu/lb)	Average Total Enthalpy EB (Btu/lb)	Average Total Enthalpy MB (Btu/lb)	Chamber Pressure (atm)	Air Flow Rate (lb/sec)	Heat Flux Calibration Model (Btu/ft²sec)	Heat Flux Center Post (Btu/ft²sec)	Center Post Stagnation Pressure (atm)	Comments
1948	9	2	19	TDNiCr 60° A7	6	311	6080	2950	2620	.159	.0107	22.9 312	(20.2)	.0061	
			20	B7											
			21	C7											
			22	A8											
			23	B8											
			24	C8											
1948	10	4	65	COATED Cb 60° A1	6	443	10,910	4740	5150	.143	.0074	43.9 MS	44.1	.0067	
			66	B1											
			67	A2											
			68	B2											
			69	A3											
			70	B3											
1949	9	2	25	TDNiCr 60° A9	6	318	6200	3040	3280	.175	.0107	23.5 315	(20.8)	.0062	
			26	B9											
			27	C9											
			22	A8	12										
			23	B8											
			24	C8											
1949	10	4	65	COATED Cb 60° A1	12	459	11,330	4419	(5300)	(.160)	.00882	45.9 460	43.0	.0068	
			66	B1											
			67	A2											
			68	B2											
			69	A3											
			70	B3											
1950	9	2	25	TDNiCr 60° A9	12	325	6290	3060	3320	.176	.0107	24.9 326	23.4	.0063	
			26	B9											
			27	C9											
			22	A8	18										
			23	B8											
			24	C8											

TABLE 2 SAMPLE TEST CONDITIONS (Continued)
METALLICS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Current (Amps)	Centerline Total Enthalpy HF (Btu/lb)	Average Total Enthalpy EB (Btu/lb)	Average Total Enthalpy MB (Btu/lb)	Chamber Pressure (atm)	Air Flow Rate (lb/sec)	Heat Flux Calibration Model (Btu/ft²sec)	Heat Flux Center Post (Btu/ft²sec)	Center Post Stagnation Pressure (atm)	Comments
1950	10	4	65	COATED Cb 60° A1	18	462	11,400	4392	5300	.160	.0082	48.4 467	42.0	.0068	
			66	B1											
			67	A2											
			68	B2											
			69	A3											
			70	B3											
1951	9	2	25	TDNiCr 60° A9	18	325	6340	3040	3380	.177	.0107	24.5 327	25.1	.0062	
			26	B9											
			27	C9											
			22	A8	24										
			23	B8											
			24	C8											
1951	10	4	65	COATED Cb 60° A1	24	475	11,670	4508	5500	.161	.0082	47.6 476	43.7	.0068	
			71	COATED Ta 60° N4	6										
			67	COATED Cb 60° A2	24										
			68	B2	24										
			72	COATED Ta 60° M4	6										
			70	COATED Cb 60° B3	24										
1952	9	2	25	TDNiCr 60° A9	24	324	6320	3090	3370	.177	.0107	25.0 327	25.2	.0063	
			26	B9											
			27	C9											
			22	A8	30										
			23	B8											
			24	C8											
1952	10	4	77	COATED Cb 60° C3	6	459	11,330	4553	5400	.160	.0082	45.6 463	42.8	.0067	
			71	COATED Ta 60° N4	12										
			67	COATED Cb 60° A2	30										
			68	B2											
			76	C2	6										
			75	C1											

TABLE 2 SAMPLE TEST CONDITIONS (Continued)
METALLICS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Current (Amps)	Centerline Total Enthalpy HF (Btu/lb)	Average Total Enthalpy EB (Btu/lb)	Average Total Enthalpy MB (Btu/lb)	Chamber Pressure (atm)	Air Flow Rate (lb/sec)	Heat Flux Calibration Model (Btu/ft²sec)	Heat Flux Center Post (Btu/ft²sec)	Center Post Stagnation Pressure (atm)	Comments
1953	10	2	78	COATED Cb 60° E1	5	428	10,550	4267	4950	.156	.0082	41.8 427	38.4	.0064	
			79	E2											
			80	E3											
			81	G1											
			82	G2											
			83	G3											
1953	10	4	77	COATED Cb 60° C3	12	431	10,640	4240	4850	.157	.0082	42.2 430	41.8	.0065	
			71	COATED Ta 60° N4	18										
			67	COATED Cb 60° A2	36										
			68	B2											
			76	C2	12										
			75	C1											
1954	10	2	84	COATED Cb 60° I1	5	452	11,150	4428	5300	.159	.0082	46.8 459	44.7	.0066	
			85	I2											
			86	I3											
			87	K1											
			88	K2											
			89	K3											
1954	10	4	77	COATED Cb 60° C3	18	447	11,020	4374	5000	.159	.0082	44.8 448	40.3	.0066	
			71	COATED Ta 60° N4	24										
			67	COATED Cb 60° A2	42										
			68	B2											
			76	C2	18										
			75	C1											
1955	10	2	90	COATED Cb 60° D1	1	446	11,000	4625	5000	.157	.0082	42.4 449	39.4	.0065	
			91	D2											
			92	D3											
			93	F1											
			94	F2											
			95	F3											

TABLE 2 SAMPLE TEST CONDITIONS (Continued)
METALLICS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Current (Amps)	Centerline Total Enthalpy HF (Btu/lb)	Average Total Enthalpy EB (Btu/lb)	Average Total Enthalpy MB (Btu/lb)	Chamber Pressure (atm)	Air Flow Rate (lb/sec)	Heat Flux Calibration Model (Btu/ft²sec)	Heat Flux Center Post (Btu/ft²sec)	Center Post Stagnation Pressure (atm)	Comments
1955	10	4	77	COATED Cb 60° C3	20	443	10,910	4643	5000	.158	.0082	42.5 43%	37.3	.0066	
			71	COATED Ta 60° N4	26										
			67	COATED Cb 60° A2	44										
			68	B2											
			76	C2	20										
			75	C1											
1956	10	2	96	COATED Cb 60° H1	1	439	10,830	4430	4900	.157	.0082	44.7 453	38.4	.0065	
			97	H2											
			98	H3											
			99	J1											
			100	J2											
			101	J3											
1956	10	4	77	COATED Cb 60° C3	22	443	10,910	4553	—	—	.0082	43.3 443	37.0	.0066	
			71	COATED Ta 60° N4	28										
			67	COATED Cb 60° A2	46										
			68	B2											
			76	C2	22										
			75	C1											
1957	10	2	102	COATED Cb 60° L1	1	500	12,300	4912	—	—	.0082	52.0 507	43.1	.0069	
			103	L2											
			104	L3											
			72	COATED Ta 60° M4	7										
			74	C5	1										
			73	C4											
1958	10	4	74	COATED Ta 60° C5	4	519	12,830	5002	5700	.167	.0082	51.3 521	55.6	.0072	
			71	N4	31										
			67	COATED Cb 60° A2	49										
			68	B2											
			76	C2	25										
			73	COATED Ta 60° C4	4										

TABLE 2 SAMPLE TEST CONDITIONS (Continued)
METALLICS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Current (Amps)	Centerline Total Enthalpy HF (Btu/lb)	Average Total Enthalpy EB (Btu/lb)	Average Total Enthalpy MB (Btu/lb)	Chamber Pressure (atm)	Air Flow Rate (lb/sec)	Heat Flux Calibration Model (Btu/ft²sec)	Heat Flux Center Post (Btu/ft²sec)	Center Post Stagnation Pressure (atm)	Comments
1959	10	4	74	COATED Ta 60° C5	5	(537)	(13,270)			.172	.0082	59.8 (550)	—	.0073	
			71	N4	32										
			67	COATED Cb 60° A2	50										
			68	B2											
			72	COATED Ta 60° M4	8										
			73	C4	5										
1960	12	2	109	COATED Ta 60° D4	1	(874)	(28,900)			(.162)	.0065	100.0 (871)	(56.7)	(.0083)	
			110	D5											
			113	F4											
			114	F5											
			117	H4											
			118	H5											
1961	12	2	121	COATED Ta 60° J4	1	(900)	(29,800)			(.155)	.0065	101.4 (900)	(47.0)	(.0060)	
			122	J5											
			125	L4											
			126	L5											
			73	C4	6										
			74	C5											
1962	12	2	111	COATED Ta 60° E4	1	(898)	(29,700)			.157	.0065	108.7 (899)	(44.0)	.0061	
			112	E5											
			115	G4											
			116	G5											
			119	I4											
			120	I5											
1963	12	2	111	COATED Ta 60° E4	2	—	—			.157	.0065	104.8 (—)	(47.1)	.0061	
			123	K4	1										
			115	G4	2										
			124	K5	1										
			119	I4	2										
			120	I5	1										

TABLE 2 SAMPLE TEST CONDITIONS (Continued)
METALLICS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Current (Amps)	Centerline Total Enthalpy HF (Btu/lb)	Average Total Enthalpy EB (Btu/lb)	Average Total Enthalpy MB (Btu/lb)	Chamber Pressure (atm)	Air Flow Rate (lb/sec)	Heat Flux Calibration Model (Btu/ft²sec)	Heat Flux Center Post (Btu/ft²sec)	Center Post Stagnation Pressure (atm)	Comments
1964	12	2	111	COATED Ta 60° E4	3	—	—			.157	.0065	78.7 (560)	(51.1)	.0060	
			123	K4	2										
			115	G4	3										
			124	K5	2										
			119	I4	3										
			120	I5	1										
1965	12	2	105	COATED Ta 60° A4	1	(900)	(29,800)			.156	.0065	102.5 (900)	(43.2)	.0060	
			106	A5	1										
			107	B4	1										
			124	K5	3										
			108	B5	1										
			120	I5	4										
1966	12	2	105	COATED Ta 60° A4	2	—	—			.157	.0065	107.1 (—)	(57.4)	.0061	
			106	A5	1										
			107	B4	1										
			124	K5	4										
			108	B5	2										
			120	I5	5										
1967	12	2	105	COATED Ta 60° A4	3	898	(29,700)			.157	.0065	80.8 (582)	(59.0)	.0061	
			72	M4	9										
			107	B4	3										
			74	C5	6										
			108	B5	3										
			73	C4	6										
1968	12	2	105	COATED Ta 60° A4	4	901	(29,800)			(.157)	.0065	112.2 (901)	(47.8)	.0060	
			72	M4	10										
			107	B4	4										
			74	C5	7										
			108	B5	4										
			73	C4	7										

TABLE 2 SAMPLE TEST CONDITIONS (Continued)
METALLICS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Current (Amps)	Centerline Total Enthalpy HF (Btu/lb)	Average Total Enthalpy EB (Btu/lb)	Average Total Enthalpy MB (Btu/lb)	Chamber Pressure (atm)	Air Flow Rate (lb/sec)	Heat Flux Calibration Model (Btu/ft²sec)	Heat Flux Center Post (Btu/ft²sec)	Center Post Stagnation Pressure (atm)	Comments
1969	12	2	105	COATED Ta 60° A4	5	(910)	(30,100)			(.157)		67.0 (581)	(50.4)	.0060	TEST TERMINATED AFTER
			71	N4	33							131.5 (971)			13 MINUTES DUE TO
			107	B4	5										SAMPLE FAILURE
			74	C5	8										
			108	B5	5										
			73	C4	5										

TABLE 2 SAMPLE TEST CONDITIONS (Continued)
SURFACE INSULATORS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Current (Amps)	Centerline Total Enthalpy HF (Btu/lb)	Average Total Enthalpy EB (Btu/lb)	Average Total Enthalpy MB (Btu/lb)	Chamber Pressure (atm)	Air Flow Rate (lb/sec)	Heat Flux Calibration Model (Btu/ft²sec)	Heat Flux Center Post (Btu/ft²sec)	Center Post Stagnation Pressure (atm)	Comments
1970	10	2	136	HCF 180° 6-1	6	548	13,600	5290	6100	.172	.0082	61.4 541	59.4	.0073	
			139	LI-1500 180° 6-1	1										
1970	10	4	135	SiC FOAM 180° 8-24	6	437	10,770	4280	5090	.159	.0082	44.6 437	47.7	.0066	
			142	LI-1500 180° 6-1	1										
1971	12	2	137	HCF 180° 6-1	1	740	24,500	8580	7830	.149	.0065	71.2 584	87.0	.0061	
			140	LI-1500 180° 6-1	1										
1972	10	2	137	HCF 180° 6-1	5	452	11,150	4340	4840	.162	.0082	44.2 439	44.5	.0066	TEST TERMINATED DUE TO CENTER POST WATER LEAK
			143	LI-1500 180° 6-1	4										
1973	9	2	136	HCF 180° 6-1	12	354	6860	3720	3980	.188	.0107	27.1 351	30.0	.0067	
			144	LI-1500 180° 6-1	6										
1973	9	4	135	SiC FOAM 180° 8-24	12	357	6930	3660	3970	.188	.0107	27.9 357	34.1	.0067	
			142	LI-1500 180° 6-1	1										
1974	10	2	127	LI-1500 180° SG 11-18	4	691	17,500	7240	8290	.193	.0082	82.0 690	(128.)	.0083	
			128	LI-1500 G 180° 11-18	1										
1974	10	4	129	LI-1500 180° 11-18	5	500	12,700	4930	5760	.167	.0082	53.6 508	70.1	.0070	
			130	LI-1500 B 180° 11-18	1										
1975	9	2	136	HCF 180° 6-1	18	372	7200	3590	4030	.190	.0107	30.3 374	33.4	.0069	
			144	LI-1500 180° 6-1	12										
1975	9	4	135	SiC FOAM 180° 8-24	18	344	6700	3470	3830	.186	.0107	27.3 346	31.9	.0067	
			142	LI-1500 180° 6-1	1										
1976	9	2	136	HCF 180° 6-1	24	378	7310	3570	4100	.191	.0107	31.4 381	33.9	.0070	
			144	LI-1500 180° 6-1	18										

TABLE 2 SAMPLE TEST CONDITIONS (Continued)
SURFACE INSULATORS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Current (Amps)	Centerline Total Enthalpy HF (Btu/lb)	Average Total Enthalpy EB (Btu/lb)	Average Total Enthalpy MB (Btu/lb)	Chamber Pressure (atm)	Air Flow Rate (lb/sec)	Heat Flux Calibration Model (Btu/ft²sec)	Heat Flux Center Post (Btu/ft²sec)	Center Post Stagnation Pressure (atm)	Comments
1976	9	4	135	Si C FOAM 180° 8-24	24	372	7200	3560	3980	.188	.0107	30.3 367	28.3	.0069	
			142	LI-1500 180° 6-1											
1977	9	2	136	HCF 180° 6-1	30	406	9850	3860	4340	.195	.0107	33.0 395	31.2	.0071	
			144	LI-1500 180° 6-1	24										
1977	9	4	135	Si C FOAM 180° 8-24	30	377	7300	3580	4050	.190	.0107	29.1 370	25.3	.0069	
			142	LI-1500 180° 6-1											
1978	10	2	145	HCF 180° 6-1	6	463	11,430	4450	5560	.165	.0082	44.7 449	45.2	.0067	
			146	LI-1500 180° 6-1											
1978	10	4	129	LI-1500 180° 11-18	11	434	10,700	4190	5320	.162	.0082	42.7 431	(29.6)	.0065	
			130	LI-1500B 180° 11-18											
1979	10	2	145	HCF 180° 6-1	12	480	11,850	4630	5720	.167	.0082	49.5 491	45.5	.0069	
			146	LI-1500 180° 6-1											
1979	10	4	129	LI-1500 180° 11-18	17	416	10,260	4020	5090	.160	.0082	39.6 417	(26.7)	.0064	
			130	LI-1500B 180° 11-18											
1980	10	2	147	HCF 180° 12-21	6	400	9850	4040	5030	.159	.0107	39.5 415	37.9	.0063	SURFACE CATALYCITY SEQUENCE DURING CYCLE 1
			148												
1980	10	4	149	HCF 180° 12-21	6	541	13,370	4930	6310	.174	.0092	59.3 544	(36.2)	.0073	SURFACE CATALYCITY SEQUENCE DURING CYCLE 2
			150												
1981	10	2	147	HCF 180° 12-21	12	390	9750	3760	4820	.156	.0082	35.9 387	33.8	.0062	
			148												
1981	10	4	149	HCF 180° 12-21	12	540	13,350	4840	6160	.172	.0082	59.1 546	(37.7)	.0073	
			150												

TABLE 2 SAMPLE TEST CONDITIONS (Continued)
SURFACE INSULATORS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Current (Amps)	Centerline Total Enthalpy HF (Btu/lb)	Average Total Enthalpy EB (Btu/lb)	Average Total Enthalpy MB (Btu/lb)	Chamber Pressure (atm)	Air Flow Rate (lb/sec)	Heat Flux Calibration Model (Btu/ft²sec)	Heat Flux Center Post (Btu/ft²sec)	Center Post Stagnation Pressure (atm)	Comments
1982	10	2	147	HCF 180° 12-21	18	392	9770	3320	3110	.161	.0082	37.4 394	34.7	.0062	
			148												
1982	10	4	151	HCF 180° 12-21	6	542	13,400	4140	3890	.176	.0082	59.4 596	(36.6)	.0073	
			152												
1983	10	2	153	REI 120° 12-9	6	394	9800	4240	4910	.157	.0082	36.5 391	32.4	.0062	
			154	HCF 120° 12-9											
			155	LI-1500G 120° 12-9											
1983	10	4	156	REI 120° 12-9	6	391	9760	4020	4900	.157	.0082	36.4 392	(26.3)	.0062	
			157	HCF 120° 12-9											
			158	LI-1500G 120° 12-9											
1984	10	2	153	REI 120° 12-9	12	391	9760	4020	4940	.158	.0082	36.0 392	35.1	.0062	
			154	HCF 120° 12-9											
			155	LI-1500G 120° 12-9											
1984	10	4	156	REI 120° 12-9	7	392	9770	3880	4950	.157	.0082	35.5 389	(29.2)	.0062	
			157	HCF 120° 12-9											
			158	LI-1500G 120° 12-9											
1984	9	4	156	REI 120° 12-9	17	352	6850	3260	4020	.110	.0107	26.6 342	26.4	.0067	
			157	HCF 120° 12-9											
			158	LI-1500G 120° 12-9											
1985	10	2	153	REI 120° 12-9	18	395	9810	3930	4130	.158	.0082	36.4 405	32.0	.0062	
			154	HCF 120° 12-9											
			155	LI-1500G 120° 12-9											
1985	9	4	156	REI 120° 12-9	18	377	7300	3360	4040	.192	.0107	28.7 364	25.9	.0069	
			157	HCF 120° 12-9											
			158	LI-1500G 120° 12-9											

TABLE 2 SAMPLE TEST CONDITIONS (Continued)
SURFACE INSULATORS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Current (Amps)	Centerline Total Enthalpy HF (Btu/lb)	Average Total Enthalpy EB (Btu/lb)	Average Total Enthalpy MB (Btu/lb)	Chamber Pressure (atm)	Air Flow Rate (lb/sec)	Heat Flux Calibration Model (Btu/ft²sec)	Heat Flux Center Post (Btu/ft²sec)	Center Post Stagnation Pressure (atm)	Comments
1986	10	2	153	REI 120° 12-9	24	392	9770	3870	4890	.157	.0082	35.4 394	30.3	.0062	
			154	HCF 120° 12-9											
			155	LI-1500G 120° 12-9											
1986	9	4	156	REI 120° 12-9	24	362	7030	3220	4020	.190	.0107	27.2 353	24.5	.0068	
			157	HCF 120° 12-9											
			158	LI-1500G 120° 12-9											
1987	10	2	153	REI 120° 12-9	30	393	9790	3730	4910	.157	.0082	35.3 392	28.8	.0062	
			154	HCF 120° 12-9											
			155	LI-1500G 120° 12-9											
1987	9	4	156	REI 120° 12-9	30	364	7050	3430	4010	.190	.0107	28.6 370	24.3	.0068	
			157	HCF 120° 12-9											
			158	LI-1500G 120° 12-9											
1990	13	2	138	HCF 180° 6-1	6	586	5150	4200	4810	.532	.0280	29.0 584	31.0	.0138	
			141	LI-1500 180° 6-1											
1990	13	4	132	SiC FOAM 180°	6	584	5120	4180	4810	.530	.0280	28.9 587	26.8	.0134	
			134												
1991	13	2	138	HCF 180° 6-1	12	587	5160	4300	4730	.529	.0280	29.4 595	26.9	.0133	
			141	LI-1500 180° 6-1											
1991	13	4	132	SiC FOAM 180°	12	579	5100	4270	4650	.523	.0280	28.4 579	28.2	.0117	
			134												
1992	13	2	138	HCF 180° 6-1	18	587	5160	4190	5100	.544	.0280	28.7 587	30.3	.0141	
			141	LI-1500 180° 6-1											
1992	13	4	132	SiC FOAM 180°	18	584	5120	4210	5110	.545	.0280	28.6 586	30.0	.0140	
			134												

TABLE 2 SAMPLE TEST CONDITIONS (Continued)
SURFACE INSULATORS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Current (Amps)	Centerline Total Enthalpy HF (Btu/lb)	Average Total Enthalpy EB (Btu/lb)	Average Total Enthalpy MB (Btu/lb)	Chamber Pressure (atm)	Air Flow Rate (lb/sec)	Heat Flux Calibration Model (Btu/ft²sec)	Heat Flux Center Post (Btu/ft²sec)	Center Post Stagnation Pressure (atm)	Comments
1993	13	2	138	HCF 180° 6-1	24	588	5160	4350	5110	.545	.0280	29.7 587	30.6	.0140	
			141	LI-1500 180° 6-1											
1993	13	4	132	S.C FOAM 180°	24	587	5160	4290	5090	.543	.0280	29.5 587	30.6	.0137	
			134												
1994	13	2	138	HCF 180° 6-1	30	587	5160	4320	5120	.544	.0280	29.2 586	29.8	.0138	
			141	LI-1500 180° 6-1											
1994	13	4	132	S.C FOAM 180°	30	588	5160	4260	5020	.542	.0280	29.4 589	31.7	.0129	
			134												

TABLE 2 SAMPLE TEST CONDITIONS (Continued)
CARBON-CARBON COMPOSITES

Test	Test Condition	Model	Sample	Sample Description	Cycle	Current (Amps)	Centerline Total Enthalpy HF (Btu/lb)	Average Total Enthalpy EB (Btu/lb)	Average Total Enthalpy MB (Btu/lb)	Chamber Pressure (atm)	Air Flow Rate (lb/sec)	Heat Flux Calibration Model (Btu/ft²sec)	Heat Flux Center Post (Btu/ft²sec)	Center Post Stagnation Pressure (atm)	Comments
2009	11	2	40	LE4A-5 360°	2	564	18,925	6630	7100	.157	.0071	80.5 568	(103.0)	.0069	
2010	11	2	38	C4A-2 360°	4	566	18,950	6760	6950	.157	.0071	79.1 567	(101.0)	.0068	

TABLE 2 SAMPLE TEST CONDITIONS (Concluded)
ABLATORS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Current (Amps)	Centerline Total Enthalpy HF (Btu/lb)	Average Total Enthalpy EB (Btu/lb)	Average Total Enthalpy MB (Btu/lb)	Chamber Pressure (atm)	Air Flow Rate (lb/sec)	Heat Flux Calibration Model (Btu/ft²sec)	Heat Flux Center Post (Btu/ft²sec)	Center Post Stagnation Pressure (atm)	Comments
2011	10	2	159	SS-41 Hc 360°	1	392	9,700	4150	4550	.152	.0082	38.7 392	—	—	
2011	10	4	160	SS-41 Hc 360°	1	391	9,650	4060	4570	.153	.0082	38.0 394	—	—	
2012	10	2	163	SS-41 360°	1	390	9,650	4090	4560	.152	.0082	38.1 389	—	—	
2012	10	4	164	SS-41 360°	1	392	9,700	4060	4580	.153	.0082	38.9 389	—	—	
2013	12	2	165	SS-41 360°	1	577	19,100	6740	7560	.148	.0065	98.7 581	—	—	
2013	12	4	166	SS-41 360°	1	578	19,100	6460	7540	.147	.0065	99.5 576	—	—	
2014	12	2	161	SS-41 HC 360°	1	577	19,100	6710	7560	.148	.0065	102.0 578	—	—	
2014	12	4	162	SS-41 Hc 360°	1	577	19,100	6620	7560	.147	.0065	101.0 575	—	—	

TABLE 3 TEST SAMPLE RESPONSE
METALLICS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cumulative Exposure Time (min)	Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature TD-7			Backwall or Midplane Temperature (°F)	Apparent Emissivity (-)	Mass Loss (grams)	Dimension Change (inch)	Comments
											Value (°F)	Range (°F)	Assumed Emissivity (-)					
1943	6	2	1	TDNiCr 60° A1	6	180	12.5	.0057	3500	.0036	1740	1720-1770	.85	1740	.85	.015	-.0016	
			2	B1							1740	1710-1770		—	—	-.002	-.0013	
			3	C1							1790	1730-1800		1800	.83	.005	-.0008	
			28	A10							1770	1740-1790		(1420)	—	.007	-.0010	
			5	B2							1770	1740-1800		1800	.79	-.001	-.0010	
			6	C2							1760	1730-1780		1810	.76	.008	-.0014	
1943	7	4	10	TDNiCr 60° A4	6	180	17.7	.0057	5150	.0034	1960	1910-1980	.85	1850	—	.020	-.0017	
			11	B4							1970	1910-2000		1970	.85	.014	-.0024	
			12	C4							1990	1960-2010		—	—	.020	-.0003	
			13	A5							1970	1930-1990		2050	.72	.017	-.0008	
			14	B5							1990	1960-2000		1940	.94	.012	-.0018	
			15	C5							1940	1920-1970		1950	.83	.015	-.0007	
1944	6	2	7	TDNiCr 60° A3	6	180	11.9	.0056	3340	.0036	1720	1700-1750	.85	1700	.89	.011	-.0002	
			8	B3							1710	1680-1760		—	—	.011	-.0014	
			9	C3							1790	1760-1800		—	—	.019	.0013	
			28	A10	12	360					1720	1690-1720		(1390)	—	.004	-.0008	
			5	B2							1730	1710-1750		—	—	.003	.0001	
			6	C2							1710	1690-1730		1760	.75	.005	.0003	
1944	7	4	16	TDNiCr 60° A6	6	180	18.4	.0056	4950	.0037	1930	1900-1990	.85	1920	.97	.030	-.0009	
			17	B6							1980	1950-1990		1890	—	.020	.0008	
			18	C6							1990	1960-2000		—	—	.023	-.0002	
			13	A5	12	360					1970	1920-1990		2030	.75	.008	-.0025	
			14	B5							1980	1940-2010		1930	.95	.018	-.0009	
			15	C5							1960	1900-1990		1890	.99	.009	-.0005	
1945	6	2	7	TDNiCr 60° A3	12	360	12.4	.0056	3430	.0036	1660	1640-1730	.85	1750	.68	.006	.0003	
			8	B3							1700	1690-1760		—	—	.006	.0004	
			9	C3							1710	1770-1920		—	—	.007	-.0002	
			28	A10	18	540					1700	1610-1730		(1420)	—	.004	-.0001	
			5	B2							1660	1620-1710		—	—	.003	.0001	
			6	C2							1610	1580-1670		—	—	.004	.0009	

TABLE 3 TEST SAMPLE RESPONSE (Continued)
METALLICS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cumulative Exposure Time (min)	Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature TD-7			Backwall or Midplane Temperature (°F)	Apparent Emissivity (-)	Mass Loss (grams)	Dimension Change (inch)	Comments
											Value (°F)	Range (°F)	Assumed Emissivity (-)					
1945	7	4	16	TDNLG 60° A6	12	360	19.6	.0057	5350	.0037	1890	1840-1980	.85	1930	.78	-.003	-.0002	
			17	B6							1910	1870-2000		1970	.89	-.009	-.0009	
			18	C6							1980	1950-2000		—	—	.026	-.0009	
			13	A5	18	540					1960	1810-2020		2020	.75	.015	.0008	
			14	B5							1900	1860-1950		1980	.72	.020	.0010	
			15	C5							1840	1810-1970		1950	.67	.017	-.0007	SOME OXIDE COATING LOST DURING RUN
1946	6	2	7	TDNLG 60° A3	18	540	12.5	.0056	3390	.0037	1720	1710-1740	.85	1790	.72	.002	-.0004	
			8	B3							1730	1710-1800		—	—	.002	.0010	
			9	C3							1790	1760-1820		—	—	-.002	-.0012	PYB 1980 °F
			28	A10	24	720					1760	1730-1770		(1460)	—	-.001	-.0001	
			5	B2							1780	1740-1790		—	—	.002	-.0005	
			6	C2							1740	1720-1760		—	—	-.001	-.0012	
1946	7	4	16	TDNLG 60° A6	18	540	18.6	.0056	4950	.0038	1920	1900-1950	.85	1920	.85	-.004	-.0004	
			17	B6							1930	1900-1970		1930	.85	.009	-.0020	
			18	C6							1940	1880-2020		—	—	-.001	-.0015	PYB 2290°F
			13	A5	24	720					1990	1970-2010		1990	.85	.007	-.0005	
			14	B5							1970	1950-1990		1960	.87	.005	-.0005	
			15	C5							1950	1920-2000		1920	.91	.008	-.0006	
1947	6	2	7	TDNLG 60° A3	24	720	12.4	.0056	3290	.0038	1710	1610-1750	.85	1760	.75	.001	-.0014	
			8	A3							1730	1700-1780		—	—	-.003	-.0017	
			9	C3							1780	1750-1800		—	—	-.008	-.0007	
			28	A10	30	900					1750	1730-1810		(1470)	—	-.002	-.0005	
			5	B2							1780	1760-1810		—	—	.005	.0038	PYB 1940°F
			6	C2							1710	1682-1740		—	—	-.008	-.0003	
1947	7	4	16	TDNLG 60° A6	24	720	(16.8)	.0056	4800	.0035	1970	1920-1980	.85	1880	—	.004	-.0017	
			17	B6							1980	1930-2010		1890	—	.006	.0005	
			18	C6							1990	1960-2010		—	—	.007	-.0010	
			13	A5	30	900					1990	1910-2010		1950	.92	.006	0	
			14	B5							1990	1960-2010		1950	.92	.005	-.0009	PYB 2300°F
			15	C5							1980	1950-2010		1890	—	.006	-.0007	

TABLE 3 TEST SAMPLE RESPONSE (Continued)
METALLICS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cumulative Exposure Time (min)	Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature TD-7 Value (°F)	Surface Temperature TD-7 Range (°F)	Surface Temperature TD-7 Assumed Emissivity (-)	Backwall or Midplane Temperature (°F)	Apparent Emissivity (-)	Mass Loss (grams)	Dimension Change (inch)	Comments
1948	9	2	19	TDNiCr 60° A1	6	180	(20.2)	.0061	6080	.0033	2100	2060 - 2180	.85	2200	.72	.040	.0005	
			20	B1							2140	2110 - 2170		—	—	.035	-.0006	
			21	C1							2150	2130 - 2210		—	—	.040	-.0018	
			22	A8							2170	2100 - 2220		(2050)	—	.049	-.0018	
			23	B8							2200	2160 - 2210		—	—	.045	-.0006	
			24	C8							2160	2080 - 2190		—	—	.036	-.0022	PYB 2370°F
1948	10	4	65	COATED CD 60° A1	6	180	44.1	.0067	10,910	.0040	2230	2190 - 2300	.85	2460	.59	-.043	-.0006	
			66	B1							2300	2250 - 2320		2410	.70	-.046	-.0014	
			67	A2							2280	2240 - 2310		—	—	-.038	-.0026	
			68	B2							2170	2110 - 2270		2520	.49	-.050	-.0028	
			69	A3							2280	2270 - 2330		—	—	-.053	-.0014	
			70	B3							2280	2260 - 2300		2390	.70	-.061	-.0010	PYB 2510°F
1949	9	2	25	TDNiCr 60° A9	6	180	(20.8)	.0062	6200	.0034	2150	2100 - 2180	.85	2210	.77	.047	-.0002	
			26	B9							2160	2130 - 2190		—	—	.042	-.0009	PYB 2330°F
			27	C9							2180	2150 - 2200		—	—	.048	-.0011	
			22	A8	12	360					2160	2140 - 2190		2130	.89	.022	-.0004	
			23	B8							2190	2140 - 2200		—	—	.028	-.0001	
			24	C8							2180	2150 - 2210		—	—	.028	-.0003	
1949	10	4	65	COATED CD 60° A1	12	360	43.0	.0068	11,330	.0038	2230	2190 - 2250	.85	2460	.59	.006	-.0007	
			66	B1							2290	2260 - 2310		2420	.68	.039	-.0003	PYB 2530°F
			67	A2							2290	2230 - 2310		—	—	.002	.0002	
			68	B2							2190	2150 - 2210		2520	.51	-.002	.0009	
			69	A3							2290	2210 - 2310		—	—	.011	.0002	
			70	B3							2300	2230 - 2370		2420	.70	.003	-.0009	
1950	9	2	25	TDNiCr 60° A1	12	360	23.4	.0063	6290	.0037	2100	2080 - 2140	.85	2230	.69	.030	.0006	
			26	B9							2160	2100 - 2190		—	—	.038	.0004	
			27	C9							2190	2160 - 2210		—	—	.037	-.0011	PYB 2290°F
			22	A8	18	540					2130	2090 - 2170		—	—	.010	-.0001	
			23	B8							2170	2120 - 2190		—	—	.026	-.0026	
			24	C8							2170	2130 - 2190		—	—	.036	-.0005	

TABLE 3 TEST SAMPLE RESPONSE (Continued)
METALLICS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cumulative Exposure Time (min)	Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature TD-7 Value (°F)	Surface Temperature TD-7 Range (°F)	Surface Temperature TD-7 Assumed Emissivity (-)	Backwall or Midplane Temperature (°F)	Apparent Emissivity (-)	Mass Loss (grams)	Dimension Change (inch)	Comments
1950	10	4	65	COATED Cb 60° A1	18	540	42.0	.0068	11,400	.0037	2270	2190-2240	.85	2440	.64	.122	-.0008	
			66	B1							2290	2240-2320		2400	.70	.350	-.0012	
			67	A2							2300	2270-2320		—	—	-.005	.0006	PYR 2450°F
			68	B2							2180	2150-2200		2490	.52	.003	.0003	
			69	A3							2270	2250-2290		—	—	.362	.0005	
			70	B3							2270	2230-2300		2420	.66	.002	-.0004	
1951	9	2	25	TDNiCr 60° A9	18	540	25.1	.0062	6340	.0040	2110	2080-2150	.85	2250	.68	.031	-.0008	
			26	B9							2150	2130-2260		—	—	.057	-.0013	
			27	C9							2200	2170-2230		—	—	.043	-.0004	PYR 2150°F
			22	A8	24	720					2180	2150-2200		—	—	.034	-.0010	
			23	B8							2180	2160-2200		—	—	.061	0	
			24	C8							2180	2160-2220		—	—	.029	.0018	
1951	10	4	65	COATED Cb 60° A1	24	720	43.7	.0065	11,670	.0037	2310	2190-2370	.85	2420	.73	.414	.0007	
			71	COATED Ta 60° N4	6	180					2120	2090-2140		—	—	.004	-.0001	
			67	COATED Cb 60° A2	24	720					2270	2240-2280		—	—	.008	-.0002	PYR 2380°F
			68	B2	24						2190	2150-2200		2480	.54	.001	-.0008	
			72	COATED Ta 60° M4	6	180					2280	2240-2300		—	—	.139	-.0005	TAB MISSING
			70	COATED Cb 60° B3	24	720					2300	2290-2320		2430	.69	.052	-.0003	
1952	9	2	25	TDNiCr 60° A9	24	720	25.2	.0063	6320	.0040	2110	2090-2160	.85	2170	.77	.044	-.0001	
			26	B9							2140	2110-2190		—	—	.074	.0011	
			27	C9							2200	2170-2220		—	—	.050	.0023	
			22	A8	30	900					2180	2140-2220		—	—	.033	.0007	
			23	B8							2160	2110-2200		—	—	.047	.0018	PYR 2470°F
			24	C8							2160	2110-2210		—	—	.044	-.0010	
1952	10	4	77	COATED Cb 60° C3	6	180	42.8	.0067	11,330	.0033	2330	2250-2340	.85	2420	.75	.067	-.0017	
			71	COATED Ta 60° N4	12	360					2100	2050-2140		—	—	.021	.0021	
			67	COATED Cb 60° A2	30	900					2240	2210-2290		—	—	-.004	-.0010	
			68	B2							2160	2140-2200		2450	.53	.003	-.0012	
			76	C2	6	180					2260	2220-2290		—	—	.188	-.0015	PYR 2370°F TAB MISSING
			75	C1							2250	2200-2290		2460	.61	-.044	-.0007	

TABLE 3 TEST SAMPLE RESPONSE (Continued)
METALLICS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cumulative Exposure Time (min)	Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature TD-7			Backwall or Midplane Temperature (°F)	Apparent Emissivity (-)	Mass Loss (grams)	Dimension Change (inch)	Comments
											Value (°F)	Range (°F)	Assumed Emissivity (-)					
1953	10	2	78	COATED Cb 60° E1	5	150	38.4	.0064	10,550	.0036	2180	2160-2230	.85	2420	.57	-.040	-.0013	PYB 2360°F
			79	E2							2190	2170-2210		—	—	-.050	-.0015	
			80	E3							2300	2270-2320		2420	.70	-.054	-.0033	
			81	G1							2180	2160-2220		—	—	-.039	-.0010	
			82	G2							2240	2200-2300		—	—	-.056	-.0020	
			83	G3							2300	2290-2350		—	—	-.061	-.0034	
1953	10	4	77	COATED Cb 60° C3	12	360	41.8	.0065	10,640	.0039	2300	2280-2320	.85	2400	.71	.202	-.0001	TAB MISSING
			71	COATED Ta 60° N4	18	540					2060	2050-2090		—	—	-.004	-.0021	
			67	COATED Cb 60° A2	36	1080					2210	2190-2230		—	—	.014	.0007	
			68	B2							2140	2100-2160		2420	.54	.001	.0006	PYB 2430°F
			76	C2	12	360					2220	2200-2250		—	—	.008	-.0003	TAB MISSING
			75	C1	1						2210	2190-2250		2430	.59	.061	-.0001	
1954	10	2	84	COATED Cb 60° I1	5	150	44.7	.0066	11,150	.0040	2240	2190-2290	.85	2420	.63	-.032	-.0018	PYB 2290°F
			85	I2							2200	2140-2260		—	—	-.007	-.0014	
			86	I3							2320	2270-2340		2440	.72	-.048	-.0017	
			87	K1							2190	2130-2280		—	—	.015	-.0030	
			88	K2							2250	2190-2300		—	—	-.050	-.0015	
			89	K3							2320	2280-2350		—	—	-.051	-.0017	
1954	10	4	77	COATED Cb 60° C3	18	540	40.3	.0066	11,020	.0037	2310	2300-2330	.85	2410	.74	.079	.0006	PYB 2360°F TAB MISSING
			71	COATED Ta 60° N4	24	720					2120	2080-2170		—	—	.079	-.0004	
			67	COATED Cb 60° A2	42	1260					2230	2210-2250		—	—	.027	-.0004	
			68	B2	1						2140	2100-2170		2420	.54	0	-.0007	
			76	C2	18	540					2220	2190-2250		—	—	.006	.0003	TAB MISSING
			75	C1							2220	2200-2240		2410	.62	.180	-.0003	
1955	10	2	90	COATED Cb 60° D1	1	30	39.4	.0065	11,000	.0036	2250	2230-2270	.85	2410	.65	-.030	-.0012	
			91	D2							2210	2190-2250		—	—	-.040	-.0008	
			92	D3							2260	2260-2270		2380	.69	-.051	-.0014	PYB (2030°F)
			93	F1							2210	2170-2220		—	—	-.037	-.0001	
			94	F2							2240	2220-2250		—	—	-.047	-.0011	
			95	F3							2300	2290-2310		—	—	-.052	-.0005	

TABLE 3 TEST SAMPLE RESPONSE (Continued)
METALLICS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cumulative Exposure Time (min)	Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature TD-7 Value (°F)	Surface Temperature TD-7 Range (°F)	Surface Temperature TD-7 Assumed Emissivity (-)	Backwall or Midplane Temperature (°F)	Apparent Emissivity (-)	Mass Loss (grams)	Dimension Change (inch)	Comments
1955	10	4	77	COATED Cb 60° C3	20	600	37.3	.0066	10,910	.0034	2300	2280-2310	.85	2410	.70	—	—	
			71	COATED Ta 60° N4	26	780					2130	2110-2130		—	—			
			67	COATED Cb 60° A2	44	1320					2210	2190-2230		—	—			PYB 2300°F
			68	B2							2130	2110-2150		2410	.53			
			76	C2	20	600					2220	2170-2240		—	—			
			75	C1							2220	2200-2230		2410	.62			
1956	10	2	96	COATED Cb 60° H1	1	30	38.4	.0065	10830	.0035	2230	2210-2250	.85	2490	.57	-.030	-.0009	
			97	H2							2210	2170-2230		—	—	-.041	-.0007	
			98	H3							2270	2240-2300		—	—	-.048	-.0003	
			99	J1							2200	2140-2250		—	—	-.033	-.0022	
			100	J2							2240	2220-2260		—	—	-.045	-.0006	
			101	J3							2300	2300-2310		—	—	-.050	-.0004	PYB 2490°F
1956	10	4	77	COATED Cb 60° C3	22	660	37.0	.0066	10,910	.0034	2300	2300-2370	.85	2420	.70	.212	-.0011	TAB MISSING
			71	COATED Ta 60° N4	28	840					2100	2010-2170		—	—	—	—	
			67	COATED Cb 60° A2	46	1380					2200	2190-2210		—	—			
			68	B2							2130	2170-2150		2400	.54			
			76	C2	22	660					2220	2200-2230		—	—			
			75	C1							2230	2210-2230		2410	.63	.166	.0006	PYB 2470°F
1957	10	2	102	COATED Cb 60° L1	1	30	43.1	.0069	12,300	.0035	2290	2280-2290	.85	2520	.60	-.030	-.0008	
			103	L2							2240	2210-2260		—	—	-.038	-.0016	
			104	L3							2270	2260-2280		2410	.67	-.036	.0011	
			72	COATED Ta 60° M4	7	210					2230	2220-2260		—	—	—	—	
			74	C5	1	30					2190	2170-2210		—	—			
			73	C4							2360	2360-2370		—	—			PYB (2100°F)
1958	10	4	74	COATED Ta 60° C5	4	120	55.6	.0072	12,830	.0043	2150	2110-2200	.85	2340	.61	—	—	
			71	N4	31	930					2180	2140-2190		—	—			
			67	COATED Cb 60° A2	49	1470					2280	2260-2300		—	—			
			68	B2							2190	2140-2200		2460	.55			
			76	C2	25	750					2300	2250-2310		—	—	.009	-.0007	PYB 2330°F TAB MISSING
			73	COATED Ta 60° C4	4	120					2360	2320-2370		—	—	—	—	

TABLE 3 TEST SAMPLE RESPONSE (Continued)
METALLICS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cumulative Exposure Time (min)	Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature TD-7 Value (°F)	Surface Temperature TD-7 Range (°F)	Surface Temperature TD-7 Assumed Emissivity (-)	Backwall or Midplane Temperature (°F)	Apparent Emissivity (-)	Mass Loss (grams)	Dimension Change (inch)	Comments
1959	10	4	74	COATED Ta 60° C5	5	150	—	.0078	—	—	(2270)	—	.85	—	—	-.081	-.003	
			71	N4	32	960					(2200)					.161	.0003	
			67	COATED Cb 60° A2	50	1500					(2300)					.296	-.0002	TAB MISSING PYB (2080)°F
			68	B2							(2220)					.007	-.0005	
			72	COATED Ta 60° M4	8	240					(2360)					.005	-.0019	TAB MISSING
			73	C4	5	150					(2270)					-.005	-.0010	
1960	12	2	109	COATED Ta 60° D4	1	30	—	(.0083)	(28900)	—	(2510)	—	.85	(2620)	—	-.051	.0001	
			110	D5							(2510)					-.148	.0003	PYB (2770)°F
			113	F4							(2580)					-.053	-.0009	
			114	F5							(2420)					-.092	-.0020	
			117	H4							(2550)					-.023	-.0024	
			118	H5							(2500)					-.093	-.0027	
1961	12	2	121	COATED Ta 60° J4	1	30	—	(.0060)	(29,800)	—	(2540)	—	.85	(2630)	—	-.137	-.0018	
			122	J5							(2540)					-.075	.0009	
			125	L4							(2540)					-.018	.0005	
			126	L5							(2450)					-.064	-.0003	PYB (2670)°F
			73	C4	6	180					(2550)					—	—	
			74	C5							(2520)							
1962	12	2	111	COATED Ta 60° E4	1	30	—	.0061	(29,700)	—	(2520)	—	.85	(2670)	—	—	—	
			112	E5							(2520)					.539	-.0024	PYB (2570)°F
			115	G4							(2530)							
			116	G5							(2500)					.825	-.0007	TAB MISSING
			119	I4							(2580)					—	—	
			120	I5							—							
1963	12	2	111	COATED Ta 60° E4	2	60	—	.0061	—	—	(2550)	—	.85	(2630)	—	—	—	
			123	K4	1	30					(2550)							
			115	G4	2	60					(2490)							
			124	K5	1	30					(2460)							
			119	I4	2	60					(2570)							
			120	I5							(2550)							PYB (2670)°F

TABLE 3 TEST SAMPLE RESPONSE (Continued)
METALLICS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cumulative Exposure Time (min)	Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature TD-7 Value (°F)	Surface Temperature TD-7 Range (°F)	Surface Temperature TD-7 Assumed Emissivity (-)	Backwall or Midplane Temperature (°F)	Apparent Emissivity (-)	Mass Loss (grams)	Dimension Change (inch)	Comments
1964	12	2	111	COATED Ta 60° E4	3	90	—	.0060	—	—	(2550)	—	.85	(2600)	—	.569	.0016	
			123	14	2	60					(2520)					.271	-.0011	
			115	G4	3	90					—					.338	.0015	
			124	K5	2	60					(2460)					—	—	
			117	I4	3	90					(2470)					.002	-.0021	
			126	I5	1						(2480)					—	—	PYB 2790 °F
1965	12	2	105	COATED Ta 60° A4	1	30	—	.0060	(29,800)	—	(2510)	—	.85	(2640)	—	—	—	
			106	A5							(2570)							
			107	B4							(2560)							PYB (2550)°F
			124	K5	3	90					(2570)							
			109	B5	1	30					(2520)							
			120	I5	4	120					(2580)							
1966	12	2	105	COATED Ta 60° A4	2	60	—	.0061	—	—	(2500)	—	.85	(2650)	—	—	—	PYB (2560)°F
			106	A5							—					1.267	.0001	TAB MISSING
			107	B4							(2550)					—	—	
			124	K5	4	120					—					.163	-.0029	
			108	B5	2	60					—					—	—	
			120	I5	5	150					(2630)					.056	-.0026	
1967	12	2	105	COATED Ta 60° A4	3	90	—	.0061	(29,700)	—	(2510)	—	.85	—	—	—	—	
			112	H4	9	270					(2530)							
			107	B4	3	90					(2550)							PYB (2510)°F
			114	G5	6	180					(2500)							
			108	B5	3	90					—							
			113	C4	6	180					—							
1968	12	2	105	COATED Ta 60° A4	4	120	—	.0060	(29,800)	—	(2410)	—	.85	(2590)	—	—	—	
			112	H4	10	300					—					1.758	.0018	
			107	B4	4	120					(2520)					—	—	PYB (2620)°F
			114	G5	7	210					(2510)							
			108	B5	4	120					—							
			113	C4	7	210					(2540)							

TABLE 3 TEST SAMPLE RESPONSE (Continued)
METALLICS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cumulative Exposure Time (min)	Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature TD-T: Value (°F)	Surface Temperature TD-T: Range (°F)	Surface Temperature TD-T: Assumed Emissivity (-)	Backwall or Midplane Temperature (°F)	Apparent Emissivity (-)	Mass Loss (grams)	Dimension Change (inch)	Comments
1969	12	2	105	COATED Ta 60 A4	5	133	—	.0060	(30,100)	—	(2520)	—	.85	(2570)	—	-.020	-.0046	PYB (2550)°F
			71	N4	33	973					(2570)					.192	.0004	
			107	B4	5	133					(2500)					-.055	0	
			74	C5	9	223					(2530)					-.063	-.0009	
			109	B5	5	133					—					1.092	-.0046	TAB MISSING
			73	C4	3	223					—					-.019	-.0003	

TABLE 3 TEST SAMPLE RESPONSE (Continued)
SURFACE INSULATORS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cumulative Exposure Time (min)	Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature TD-7			Backwall or Midplane Temperature (°F)	Apparent Emissivity (-)	Mass Loss (grams)	Dimension Change (inch)	Comments
											Value (°F)	Range (°F)	Assumed Emissivity (-)					
1970	10	2	136	HCF 180° 6-1	6	180	59.4	.0073	13,600	.0044	2260 2180	2130 - 2290	.75	1100	.82	.274	-.0024	PYB 2130°F
			139	LI-1500 180° 6-1							2610 2560	2130-2700	.35	870		.936	—	
1970	10	4	135	SiC FOAM 180° 8-24	6	180	47.7	.0066	10,770	.0044	2200 2200	2110-2210	.85	930	—	.120	-.0009	PYB 1930°F
			142	LI-1500 180° 6-1							2420 2320	2280-2240	.35	740		.269	.0252	
1971	12	2	137	HCF 180° 6-1	1	24	87.0	.0061	24,500	.0036	2600 2520	2510-2610	.75	1350		—	—	
			140	LI-1500 180° 6-1							2960 2960	2530-3050	.35	—	.24	1.636	—	PYB 3300°F
1972	10	2	137	HCF 180° 6-1	5	125	44.5	.0066	11,150	.0040	2180 2190	2050-2190	.75	1220		—	—	WATER LEAK
			143	LI-1500 180° 6-1	4	95					2510 2360	2340-2520	.35	600	.20	—	—	PYB 2800°F WATER LEAK
1973	9	2	136	HCF 180° 6-1	12	360	30.0	.0067	6860	.0044	1960 1920	1890-2000	.75	810	.52	.077	.0004	PYB 2100°F
			144	LI-1500 180° 6-1	6	180					2230 2170	2120-2380	.35	520		.143	.0176	
1973	9	4	135	SiC FOAM 180° 8-24	12	360	34.1	.0067	6930	.0049	2080 2060	1980-2100	.85	820	.87	.038	.0002	PYB 2050°F
			142	LI-1500 180° 6-1							2220 2160	2130-2290	.35	620		.043	.0028	
1974	10	2	127	LI-1500 180° SG 11-18	4	95	(128)	.0083	17,500	.0019	2470 2390	2350-2510	.83	1420		.585	.0699	
			128	LI-1500 180° G 11-18							2480 2360	2340-2530		640	.64	.510	.0122	PYB 2560°F

TABLE 3 TEST SAMPLE RESPONSE (Continued)
SURFACE INSULATORS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cumulative Exposure Time (min)	Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature TD-7			Backwall or Midplane Temperature (°F)	Apparent Emissivity (-)	Mass Loss (grams)	Dimension Change (inch)	Comments
											Value (°F)	Range (°F)	Assumed Emissivity (-)					
1974	10	4	129	LI-1500 180° 11-18	5	150	70.1	.0070	12,700	.0055	2510 2510	2440-2520	.35	1180		.296	.576	
			130	LI-1500 B 180° 11-18							2370 2340	2290-2430	.65	590	.63	.047	-.0006	PYB 2360°F
1975	9	2	136	HCF 180° 6-1	18	540	33.4	.0069	7200	.0046	1970 1910	1890-1930	.75	680	.47	.039	-.0009	PYB 2140°F
			144	LI-1500 180° 6-1	12	360					2190 2140	2110-2200	.35	510		.078	.0002	
1975	9	4	135	SiC FOAM 180° 8-4	18	540	31.9	.0067	6700	.0048	2070 2040	1960-2110	.85	840	.80	.035	.0103	PYB 2070°F
			142	LI-1500 180° 6-1							2230 2160	2110-2270	.35	660		.039	-.0031	
1976	9	2	136	HCF 180° 6-1	24	720	33.9	.0070	7310	.0046	1970 1940	1920-1990	.75	670	.49	.028	-.0006	PYB 2160°F
			144	LI-1500 180° 6-1	18	540					2200 2140	2100-2210	.35	520		.098	0	
1976	9	4	135	SiC FOAM 180° 8-22	24	720	28.3	.0069	7200	.0039	2070 2050	1950-2110	.85	860	.83	.010	-.0100	PYB 2060°F
			142	LI-1500 180° 6-1							2300 2260	2160-2340	.35	730		.075	-.0027	
1977	9	2	136	HCF 180° 6-1	30	900	37.2	.0071	7850	.0047	2020 1990	1930-2030	.75	910	.51	.003	.0006	PYB 2180°F
			144	LI-1500 180° 6-1	24	720					2190 2160	2130-2220	.35	580		.158	-.0005	
1977	9	4	135	SiC FOAM 180° 8-34	30	900	25.3	.0061	7300	.0035	2060 2040	1960-2090	.85	890	.87	.060	-.0019	PYB 2050°F
			142	LI-1500 180° 6-1							2310 2260	2190-2330	.35	780		.082	.0035	

TABLE 3 TEST SAMPLE RESPONSE (Continued)
SURFACE INSULATORS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cumulative Exposure Time (min)	Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature TD-7			Backwall or Midplane Temperature (°F)	Apparent Emissivity (-)	Mass Loss (grams)	Dimension Change (inch)	Comments
											Value (°F)	Range (°F)	Assumed Emissivity (-)					
1978	10	2	145	HCF 180° 6-1	6	180	45.2	.0067	11,430	.0040	2150	1900-2130	.75	1020		.172	-.0023	
											2140				.65			PYB 2230°F
			146	LI-1500 180° 6-1							2500	2310-2520	.35	610		.282	.0297	
											2390							
1978	10	4	129	LI-1500 180° 11-18	11	330	29.6	.0065	10,700	.0028	2510	2430-2520	.35	1340		.175	.0022	
											2510				.35			PYB 2510°F
			130	LI-1500B 180° 11-18							2290	2190-2310	.65	690		-.021	.0024	
											2220							
1979	10	2	145	HCF 180° 6-1	12	360	45.5	.0069	11,850	.0038	2200	2130-2210	.75	1110		.092	.0018	
											2200							
			146	LI-1500 180° 6-1							2510	2360-2520	.35	650		.362	.0024	
											2380				.17			PYB 2960°F
1979	10	4	129	LI-1500 180° 11-18	17	510	(26.7)	.0064	10,260	(.0026)	2510	2400-2530	.35	1450		.140	.0027	
											2510							
			130	LI-1500B 180° 11-18							2260	2150-2280	.65	69		-.051	-.0023	
											2170				.57			PYB 2250°F
											TD-9							
1980	10	2	147	HCF 180° 12-21	6	180	37.9	.0063	9850	.0038	2180	2060-2360	.75	900		.094	-.0126	
											2180				.36			PY-7 1820°F
			148								2200	2040-2390		780		.094	-.0135	
											2130							PYB 2280°F
1980	10	4	149	HCF 180° 12-21	6	180	(36.2)	.0073	13,370	(.0027)	2400	2070-2420	.75	1130		.211	-.0095	
											2400				.43			PY-7 2070°F
			150								2410	2320-2430		970		.259	-.0133	
											2380							PYB 2480°F
1981	10	2	147	HCF 180° 12-21	12	360	33.8	.0062	9750	.0035	2190	2150-2220	.75	890		.036	-.0070	
											2190							PYB 2090°F
			148								2210	2120-2240		800		.037	-.0080	
											2150				.36			PY-7 1800°F

TABLE 3 TEST SAMPLE RESPONSE (Continued)
SURFACE INSULATORS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cumulative Exposure Time (min)	Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature TD-9			Backwall or Midplane Temperature (°F)	Apparent Emissivity (-)	Mass Loss (grams)	Dimension Change (inch)	Comments
											Value (°F)	Range (°F)	Assumed Emissivity (-)					
1981	10	4	149	HCF 180 12-21	12	360	(31.7)	.0073	13,350	(.0028)	2490	2390 - 2510	.75	1370		.791	-.0128	
											2470							PYB 2350°F
			150								2480	2390 - 2510		1130		.163	-.0063	
											2430				.41			PY-7 2070°F
1982	10	2	147	HCF 180° 12-21	18	540	34.7	.0062	9770	.0036	2210	2180 - 2330	.75	930		1.082	.0148	
											2200							PYB 2110°F
			148								2220	2110 - 2390		830		.042	-.0146	
											2170				.44			PY-7 1900°F
1982	10	4	151	HCF 180° 12-21	6	180	(35.6)	.0073	13,400	(.0027)	2420	2310 - 2450	.75	1200		-.131	-.0124	
											2420							PYB 2310°F
			152								2430	2310 - 2450		1240		.032	-.0121	
											2310				.47			PY-7 2100°F
1983	10	2	153	REI 120° 12-9	6	180	32.4	.0062	9800	.0033	2160	2120 - 2170	.75	960	/.34	.063	-.0027	PYB 2030°F PY-7 1780°F
			154	HCF 120° 12-9							2530	2410 - 2550	.75	1220		.321	-.0065	
			155	LI-1500G 120° 12-9							2000	2030 - 2150	.83	570		.030	-.0010	
1983	10	4	156	REI 120° 12-9	6	180	(26.3)	.0062	9760	(.0027)	2160	2130 - 2170	.75	980	/.32	.095	.0057	PYB 2050°F PY-7 1760°F
			157	HCF 120° 12-9							2540	2510 - 2580	.75	1290		.389	-.0030	
			153	LI-1500G 120° 12-9							2070	2050 - 2270	.83	670		.046	.0002	
1984	10	2	153	REI 120° 12-9	12	360	35.1	.0062	9760	.0036	2160	2130 - 2180	.75	990	/.33	.035	-.0018	PYB 2040°F PY-7 1770°F
			154	HCF 120° 12-9							2500	2300 - 2560	.75	1190		.064	-.0034	
			155	LI-1500G 120° 12-9							2050	2040 - 2068	.83	570		.016	-.0005	
1984	9	4	156	REI 120° 12-9	12	360	26.4	.0067	9770	.0027	2060	2020 - 2090	.75	980	/.31	.012	-.0007	PYB 2000°F PY-7 1670°F
			157	HCF 120° 12-9							2410	2440 - 2530	.75	1230		.034	-.0001	
			158	LI-1500G 120° 12-9							1950	1940 - 2040	.83	690		.012	-.0001	
1985	10	2	153	REI 120° 12-9	18	540	32.0	.0062	6850	.0047	2180	2150 - 2200	.75	1020		.029	.0079	
			154	HCF 120° 12-9							2230	2170 - 2270	.75	1140	.44	.054	.0039	PY-7 1950°F
			155	LI-1500G 120° 12-9							2010	2040 - 2110	.83	640		.015	.0005	PYB 2040°F

TABLE 3 TEST SAMPLE RESPONSE (Continued)
SURFACE INSULATORS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cumulative Exposure Time (min)	Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature TD-9			Backwall or Midplane Temperature (°F)	Apparent Emissivity (-)	Mass Loss (grams)	Dimension Change (inch)	Comments
											Value (°F)	Range (°F)	Assumed Emissivity (-)					
1985	9	4	156	REI 120° 12-9	18	540	25.9	.0069	7300	.0035	2110	2040 - 2130	.75	1040		.025	.0012	
			157	HCF 120° 12-9							2420	2220 - 2570	.75	1260	.48	.042	.0010	PY-7 2160°F
			158	LI-1500 120° 12-9							2000	1960 - 2030	.83	780		.011	.0002	PYB 1180°F
1986	10	2	153	REI 120° 12-9	24	720	30.3	.0062	9770	.0031	2170	2150 - 2190	.75	1020		.026	-.0057	
			154	HCF 120° 12-9							2180	2150 - 2210	.75	1080		.033	-.0039	PYB 2190°F
			155	LI-1500 120° 12-9							2080	2060 - 2170	.83	650	.58	.013	-.0012	PY-7 1900°F
1986	9	4	156	REI 120° 12-9	24	720	24.5	.0063	7030	.0034	2070	2040 - 2130	.75	1040		.030	-.0039	
			157	HCF 120° 12-9							2230	2170 - 2260	.75	1220		.030	-.0026	PYB 2290°F
			158	LI-1500 120° 12-9							1990	1950 - 2030	.83	790	.53	.011	-.0017	PY-7 1790°F
1987	10	2	153	REI 120° 12-9	30	900	29.3	.0068	9790	.0029	2170	2140 - 2190	.75	1020		.020	.0033	PYB 1910°F
			154	HCF 120° 12-9							2170	2140 - 2210	.75	1070	.44	.027	-.0026	PY-7 1900°F
			155	LI-1500 120° 12-9							2040	2000 - 2120	.83	670		.013	.0005	
1987	9	4	156	REI 120° 12-9	30	900	29.3	.0068	7050	.0034	2010	1930 - 2050	.75	1060		-.010	.0119	PYB 1860°F
			157	HCF 120° 12-9							2190	2120 - 2260	.75	1210	.44	.038	-.0017	PY-7 1960°F
			158	LI-1500 120° 12-9							2020	1960 - 2070	.83	820		.011	-.0014	
											TD-7							
1990	13	2	138	HCF 180° 6-1	6	180	31.0	.1380	5150	.0060	2050	1910 - 2070	.75	1280	.58	.173	-.0008	PY-9 2200°F
			141	LI-1500 180° 6-1							2450	2210 - 2510	.35	880	.26/.36	.157	.0253	PYB 2690°F PY-9 2430°F
1990	13	4	132	SiC FOAM 180°	6	180	26.8	.1340	5120	.0052	1860	1820 - 1840	.85	1280	—	2.569	.0021	PY-9 2320°F
			134								2170	2120 - 2210		1010	.82/.90	-.132	.0016	PYB 2190°F PY-9 2140°F
1991	13	2	138	HCF 180° 6-1	12	360	26.9	.1330	5160	.0052	2060	1980 - 2070	.75	1080	.64	.065	.0007	PYB 2150°F
			141	LI-1500 180° 6-1							2370	2120 - 2390	.35	800	.31	.043	.0001	PY-9 2470°F
1991	13	4	132	SiC FOAM 180°	12	360	28.2	.1170	5100	.0055	2200	2110 - 2270	.85	1120	.86	.001	-.0012	PYB 2190°F
			134								2140	1960 - 2160		1030	.87	-.059	-.0001	PY-9 2120°F
1992	13	2	138	HCF 180° 6-1	18	540	30.3	.1410	5160	.0059	—	—	.75	1130	—	.042	.0002	PYB 2210°F
			141	LI-1500 180° 6-1							2270	2110 - 2310	.35	830	.27	.056	-.0006	PY-9 2540°F

TABLE 2 SAMPLE TEST CONDITIONS (Continued)
CARBON-CARBON COMPOSITES

Test	Test Condition	Model	Sample	Sample Description	Cycle	Current (Amps)	Centerline Total Enthalpy HF (Btu/lb)	Average Total Enthalpy EB (Btu/lb)	Average Total Enthalpy MB (Btu/lb)	Chamber Pressure (atm)	Air Flow Rate (lb/sec)	Heat Flux Calibration Model (Btu/ft²sec)	Heat Flux Center Post (Btu/ft²sec)	Center Post Stagnation Pressure (atm)	Comments
1998	12	2	169	PF-B-1 180°	5	557	21,750	7650	7940	.153	.0065	96.0 654	(132)	.0065	
			170	PF-B-2 180°											
1998	12	4	167	E4A-3-1 180°	4	555	21,700	7740	7930	.151	.0065	97.2 654	(117)	.0065	
			168	E4A-3-2 180°											
1999	11	2	47	PF-D-1 180°	6	565	18,950	6240	7010	.157	.0071	79.1 563	(98.7)	.0068	
			48	PF-D-2 180°											
1999	11	4	55	E4A-4-1 180°	6	563	18,925	6080	7040	.157	.0071	73.6 559	(94.8)	.0068	
			51	E4A-2-1 180°											
2000	11	2	47	PF-D-1 180°	12	566	18,950	6210	7070	.158	.0071	75.9 564	(98.3)	.0068	
			48	PF-D-2 180°											
2000	11	4	55	E4A-4-1 180°	12	567	19,000	6240	7110	.158	.0071	75.0 567	(87.4)	.0068	
			51	E4A-2-1 180°											
2001	11	2	45	PF-C-1 180°	6	567	19,000	6300	7050	.157	.0071	76.0 566	(93.8)	.0069	
			48	PF-D-2 180°	18										
2001	11	4	55	E4A-4-1 180°	17	566	18,950	6410	6960	.157	.0071	74.6 564	(68.6)	.0068	
			51	E4A-2-1 180°											
2002	11	2	45	PF-C-1 180°	12	567	19,000	6750	7380	.160	.0071	75.9 568	(89.2)	.0069	
			48	PF-D-2 180°	24										
2002	11	4	46	PF-C-2 180°	6	567	19,000	6690	7320	.160	.0071	77.6 567	(79.8)	.0069	
			56	E4A-4-2 180°											
2003	11	2	49	E4A-1-1 180°	6	564	18,925	6160	7110	.157	.0071	77.0 565	(94.1)	.0068	
			48	PF-D-2 180°	30										

TABLE 2 SAMPLE TEST CONDITIONS (Continued)
CARBON-CARBON COMPOSITES

Test	Test Condition	Model	Sample	Sample Description	Cycle	Current (Amps)	Centerline Total Enthalpy HF (Btu/lb)	Average Total Enthalpy EB (Btu/lb)	Average Total Enthalpy MB (Btu/lb)	Chamber Pressure (atm)	Air Flow Rate (lb/sec)	Heat Flux Calibration Model (Btu/ft²sec)	Heat Flux Center Post (Btu/ft³sec)	Center Post Stagnation Pressure (atm)	Comments
2003	11	4	46	PF-C-2 180°	12	565	18,950	5890	7070	.157	.0071	77.0 568	(81.7)	.0069	
			56	E4A-4-2 180°											
2004	11	2	37	C4A-1 360°	1	563	18,925	6140	7150	.158	.0071	77.5 558	(93.2)	.0069	
2004	11	4	172	DA 0.5 60°	1	563	18,925	6440	7120	.158	.0071	79.2 566	—	.0069	
			62	EHI-1 60°											
			174	E-1 60°											
			175	DIH-5 60°											
			176	DIA 1.5-1 60°											
			177	DA 1.5 60°											
2005	11	2	37	C4A-1 360°	2	565	18,950	6600	7110	.158	.0071	78.4 567	(94.3)	.0069	
2005	11	4	180	E2 60°	1	565	18,950	6150	7100	.158	.0071	77.4 561	—	.0069	
			62	EHI-1 60°	2										
			174	E-1 60°											
			175	DIH-5 60°											
			178	4H7 60°	1										
			179	5H8 60°											
2006	11	2	37	C4A-1 360°	6	566	18,950	6220	7080	.158	.0071	78.7 565	(97.7)	.0068	
2006	11	4	180	E2 60°	2	568	19,000	6310	7250	.158	.0071	79.7 572	—	.0069	
			62	EHI-1 60°	3										
			58	DH-1 60°	1										
			59	DH-3 60°											
			178	4H7 60°	2										
			179	5H8 60°											
2007	11	2	39	C4A-3 360°	6	565	18,950	6220	7130	.158	.0071	78.5 566	(99.9)	.0068	
2008	11	2	39	C4A-3 360°	12	565	18,950	6200	7100	.158	.0071	79.0 561	(101.0)	.0068	

TABLE 3 TEST SAMPLE RESPONSE (Continued)
SURFACE INSULATORS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cumulative Exposure Time (min)	Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature TD-7			Backwall or Midplane Temperature (°F)	Apparent Emissivity (-)	Mass Loss (grams)	Dimension Change (inch)	Comments
											Value (°F)	Range (°F)	Assumed Emissivity (-)					
1992	13	4	132	SiC FOAM 180°	18	540	30.0	.1400	5120	.0059	2200	2010-2210	.85	1100	.66	-.013	-.0001	PYB 2340°F
			134								2130	2010-2140		930	.79	.048	-.0008	PY-9 2170°F
1993	13	2	138	HCF 180° 6-1	24	720	30.6	.1400	5160	.0059	2060	2020-2080	.75	1170	.43	.005	.0002	PYB 2380°F
			141	LI-1500 180°6-1							2310	2060-2340	.35	850	.27	.056	.0001	PY-9 2510°F
1993	13	4	132	SiC FOAM 180°	24	720	30.6	.1370	5160	.0059	2210	2170-2240	.85	1210	.63	-.036	-.0006	PYB 2310°F
			134								2110	1980-2130		990	.83	-.092	.0001	PY-9 3130°F
1994	13	2	138	HCF 180° 6-1	30	900	29.8	.1380	5160	.0058	2060	2040-2080	.75	1170	.43	.005	-.0004	PYB 2380°F
			141	LI-1500 180° 6-1							2280	2010-2300	.35	970	.26	.274	.0004	PY-9 2470°F
1994	13	4	132	SiC FOAM 180°	30	900	31.7	.1290	5160	.0061	2180	2150-2200	.85	1200	.61	-.034	-.0003	PYB 2370°F
			134								2100	1950-1050		1050	.83	1.406	0	PY-9 2110°F

TABLE 3 TEST SAMPLE RESPONSE (Continued)
CARBON-CARBON COMPOSITES

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cumulative Exposure Time (min)	Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature TD-9 Value (°F)	Surface Temperature TD-9 Range (°F)	Surface Temperature TD-9 Assumed Emissivity (-)	Backwall or Midplane Temperature (°F)		Mass Loss (grams)	Dimension Change (inch)	Comments
1998	12	2	169	PF-B-1 180°	5	150	96.0	.0065	21,750	.0044	2700	2530-2800	.85	1410		23.475	.0349	PY-7 2430 °F
			170	PF-B-2 180°							2660	2420-2900		1260		29.425	—	PYB 2580 °F
1998	12	4	167	E4A-3-1 180°	4	120	97.2	.0065	21,700	.0045	2350	2270-2410	.85	1670		9.577	-.0086	PY-7 2215 °F
			169	E4A-3-2 180°							2330	2220-2360		1610		6.141	.0027	PYB 2360 °F
1999	11	2	47	PF-D-1 180°	6	180	74.1	.0068	18,950	.0039	2310	2000-2530	.85	1420		18.842	.0012	PY-7 2095 °F
			48	PF-D-2 180°							2100	1960-2120		1770		2.923	.0003	PYB 2080 °F
1999	11	4	55	E4A-4-1 180°	6	180	73.6	.0068	18,925	.0039	2180	1960-2190	.85	1270		11.646	.0012	PY-7 2037 °F
			51	E4A-2-1 180°							2140	1970-2190		1130		12.094	.0019	PYB 2140 °F
2000	11	2	47	PF-D-1 180°	12	360	75.9	.0068	18,950	.0040	2570	2270-2620	.85	1110		17.506	.0177	PYB 2320 °F
			48	PF-D-2 180°							2100	230-2170		—		0.688	.0006	PY-7 1855 °F
2000	11	4	55	E4A-4-1 180°	12	360	75.0	.0068	19,000	.0039	2210	2080-2320	.85	1530		14.123	-.0062	PYB 2150 °F
			51	E4A-2-1 180°							2180	2050-2220		1060		13.521	-.0013	PY-7 1959 °F
2001	11	2	45	PF-C-1 180°	6	180	76.0	.0068	19,000	.0040	2800	2610-2860	.85	1440		16.294	.0015	PY-7 2551 °F
			43	PF-D-2 180°	18	540					2200	2170-2230		1700		1.696	-.0018	PYB 2410 °F
2001	11	4	55	E4A-4-1 180°	17	4-11	74.6	.0063	18,950	.0039	2220	2160-2270	.85	1290		7.641	-.0177	PY-7 2057 °F
			51	E4A-2-1 180°							2200	2150-2210		1000		13.300	—	PYB 2230 °F
2002	11	2	45	PF-C-1 180°	12	360	75.9	.0071	19,000	.0040	2400	2280-2460	.85	850		6.839	.0097	PY-7 2622 °F
			43	PF-D-2 180°	24	720					2110	2160-2220		—		2.353	.0007	PYB 2270 °F
2002	11	4	46	PF-C-2 180°	6	180	77.6	.0071	19,000	.0041	2400	2270-2460	.85	1570		16.783	.0137	PY-7 2580 °F
			56	E4A-4-2 180°							2270	2210-2330		1530		7.476	.0007	PYB 2240 °F
2003	11	2	49	E4A-1-1 180°	6	180	77.0	.0069	18,925	.0041	2180	2140-2260	.85	1270		5.621	-.0002	PY-7 1934 °F
			48	PF-D-2 180°	30	900					2150	2110-2170		—		3.206	.0016	PYB 2370 °F

TABLE 3 TEST SAMPLE RESPONSE (Continued)
CARBON-CARBON COMPOSITES

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cumulative Exposure Time (min)	Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature TD-9 Value (°F)	Surface Temperature TD-9 Range (°F)	Surface Temperature TD-9 Assumed Emissivity (-)	Backwall or Midplane Temperature (°F)		Mass Loss (grams)	Dimension Change (inch)	Comments
2003	11	4	46	PF-C-2 180°	12	360	77.0	.0069	18,950	.0041	2920	2810-2930	.85	1050		7.184	.0046	PY-7 2601 °F
			56	EAA-A-2 180°							2270	2180-2280		1370		10.166	.0036	PYB 2220°F
2004	11	2	37	CAA-1 360°	1	30	77.5	.0069	18,925	.0041	2130	2080-2140	.85	1570		—	—	PYB 2120°F PY-7 1909 °F
2004	11	4	172	DA 0.5 60°	1	18	79.2	.0069	18,925	.0042	2720	2560-2780	.85	2420		5.474	—	PYB 2590°F
			62	EMI-1 60°							2320	2310-2320		1850		—	—	
			174	E-1 60°							2580	2580-2590		840				
			175	DIH-5 60°							2210	2110-2260		1150				PY-7 1930 °F
			176	DIA 1.5-1 60°							2490	2390-2590		1630		3.762	—	
			177	DA 1.5 60°							2560	2510-2680		1860		3.746	—	
2005	11	2	37	CAA-1 360	2	60	78.4	.0069	18,950	.0041	2130	2080-2140	.85	1550		—	—	PYB 2130°F PY-7 1885 °F
2005	11	4	180	E2 60°	1	27	77.4	.0069	18,950	.0041	2640	2620-2650	.85	—		—	—	PYB 2510°F
			62	EMI-1 60°	2	45					2360	2350-2360		1900				
			174	E-1 60°							2680	2640-2710		1840		5.368	-.0067	
			175	DIH-5 60°							2270	2260-2290		1970		2.610	-.0037	PY-7 1989 °F
			178	4H7 60°	1	27					2370	2340-2490		2030		—	—	
			179	5H8 60°							2280	2260-2690		2130				
2006	11	2	37	CAA-1 360°	6	180	78.7	.0068	18,950	.0042	2180	2100-2190	.85	1560		11.932	.0085	PYB 2100°F PY-7 1911 °F
2006	11	4	180	E2 60°	2	57	79.7	.0069	19,000	.0042	2650	2640-2700	.85	—		4.790	.0082	PYB 2430°F
			62	EMI-1 60°	3	75					2340	2310-2360		1500		1.973	-.0068	
			58	DH-1 60°	1	30					2380	2350-2430		1840		2.266	-.0057	
			59	DH-3 60°							2340	2300-2460		1420		1.287	-.0024	PY-7 2101 °F
			178	4H7 60°	2	57					2600	2470-2650		1580		2.553	—	
			179	5H8 60°							2710	2650-2710		2020		5.815	—	
2007	11	2	39	C4A-3 360°	6	180	78.5	.0068	18,950	.0041	2150	2060-2160	.85	1480		11.171	-.0080	PYB 2190°F PY-7 1900°F
2008	11	2	39	C4A-3 360°	12	360	79.0	.0068	18,950	.0042	2170	2090-2180	.85	1350		10.973	.0190	PYB 2190°F PY-7 1854 °F

TABLE 3 TEST SAMPLE RESPONSE (Continued)
CARBON-CARBON COMPOSITES

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cumulative Exposure Time (min)	Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature TD-9			Backwall or Midplane Temperature (°F)		Mass Loss (grams)	Dimension Change (inch)	Comments
											Value (°F)	Range (°F)	Assumed Emissivity (-)					
2009	11	2	40	EAA-5 360°	2	40	80.5	.0068	18,925	.0043	2320	2100-2320	.85	1600		6.058	.0020	PYB 2160°F PY-7 1882 °F
2010	11	2	38	CAA-2 360°	4	120	79.1	.0068	18,150	.0042	2170	2110-2420	.85	1630		17.018	0.0	PYB 2190°F PY-7 1925 °F

TABLE 3 TEST SAMPLE RESPONSE (Concluded)
ABLATORS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cumulative Exposure Time (min)	Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature TD-9			Backwall or Midplane Temperature (°F)	Char Depth (inch)	Mass Loss (grams)	Dimension Change (inch)	Comments
											Value (°F)	Range (°F)	Assumed Emissivity (-)					
2011	10	2	159	SS-41 Hc 360°	1	16.67	38.7	—	9,700	.0040	2020	1980-2050	.85	178	.74	29.795	.057-.032	PYB 1920°F PY-T 1925°F
2011	10	4	160	SS-41 Hc 360°	1	33.33	38.0	—	9,650	.0039	2020	1960-2040	.85	305	1.09	36.700	.079-.049	PYB 2040°F PY-T 1902°F
2012	10	2	163	SS-41 360°	1	16.67	38.1	—	9,650	.0039	2030	1990-2060	.85	165	.75	28.500	.063-.038	PYB 2110°F PY-T 1952°F
2012	10	4	164	SS-41 360°	1	3333	38.9	—	9,700	.0040	2020	1960-2050	.85	306	1.13	34.700	.085-.030	PYB 2100°F PY-T 1932°F
2013	12	2	165	SS-41 360°	1	16.67	98.7	—	19,100	.0052	2540	2410-2610	.85	233	1.14	34.900	.115-.065	PYB 2690°F PY-T 2487°F
2013	12	4	166	SS-41 360°	1	33.33	99.5	—	19,100	.0052	2670	2530-2690	.85	526	1.38	45.900	.191-.061	PYB 2750°F PY-T 2556°F
2014	12	2	161	SS-41 Hc 360°	1	16.67	102.0	—	19,100	.0053	2570	2400-2620	.85	242	1.14	34.900	.104-.054	PYB 2700°F PY-T 2513°F
2014	12	4	162	SS-41 Hc 360°	1	3333	101.0	—	19,100	.0053	2670	2330-2720	.85	514	1.39	45.500	.166-.096	PYB 2740°F PY-T 2519°F

TABLE 4 TEST SAMPLE PERFORMANCE SUMMARY
METALLICS

Test	Test Condition	Model	Sample	Sample Description	End Cycle	Total Exposure Time (min)	Sample Response and Performance Characteristics
1943	6	2	1	TDN.Cr 60° A1	6	180	NO CHANGE
			2	B1	6	180	
			3	C1	6	180	
1947	6	2	28	A10	30	900	
			5	B2	30	900	
			6	C2	30	900	
1943	7	4	10	A4	6	180	
			11	B4	6	180	
			12	C4	6	180	PARTIAL LOSS OF OXIDE COATING
1947	7	4	13	A5	30	900	NO CHANGE
			14	B5	30	900	
			15	C5	30	900	
1947	6	2	7	A3	24	720	
			8	B3	24	720	
			9	C3	24	720	
1947	7	4	16	A6	24	720	
			17	B6	24	720	PARTIAL LOSS OF OXIDE COATING AFTER CYCLE 12
			18	C6	24	720	PARTIAL LOSS OF OXIDE COATING AFTER CYCLE 12
1948	9	2	19	A7	6	180	NO CHANGE
			20	B7	6	180	
			21	C7	6	180	
1952	9	2	22	A8	30	900	
			23	B8	30	900	PARTIAL LOSS OF OXIDE COATING AFTER CYCLE 18
			24	C8	30	900	PARTIAL LOSS OF OXIDE COATING AFTER CYCLES 6 & 12
			25	A9	24	720	NO CHANGE
			26	B9	24	720	PARTIAL LOSS OF OXIDE COATING AFTER CYCLES 12 & 24
			27	C9	24	720	PARTIAL LOSS OF OXIDE COATING AFTER CYCLE 6
1951	10	4	65	COATED Cb_2 60° A1	24	720	COATING DEGRADATION STARTED BETWEEN CYCLES 0-6
1950	10	4	66	B1	18	540	COATING DEGRADATION STARTED BETWEEN CYCLES 0-6
1959	10	4	67	A2	50	1500	COATING DEGRADATION STARTED BETWEEN CYCLES 6-12
			68	B2	50	1500	COATING DEGRADATION STARTED BETWEEN CYCLES 36-42
1950	10	4	69	A3	18	540	COATING DEGRADATION STARTED BETWEEN CYCLES 6-12
1951	10	4	70	B3	24	720	COATING DEGRADATION STARTED BETWEEN CYCLES 0-6
1969	10/12	4/2	71	COATED Ta_2 60° N4	33	973	LOCAL SUBSTRATE OXIDATION STARTED BETWEEN CYCLES 0-6

TABLE 4 TEST SAMPLE PERFORMANCE SUMMARY (Continued)
METALLICS

Test	Test Condition	Model	Sample	Sample Description	End Cycle	Total Exposure Time (min)	Sample Response and Performance Characteristics
1968	10/12	4/2	72	COATED Ta 60° M4	10	300	CROSS FAILURE AT CYCLE 10
1956	10	4	77	COATED Cb 60° C3	22	660	COATING DEGRADATION STARTED BETWEEN CYCLES 0-6
1958	10	4	76	C2	25	750	NO CHANGE
1956	10	4	15	C1	22	660	COATING DEGRADATION STARTED BETWEEN CYCLES 0-6
1953	10	2	78	E1	5	150	HOLE DEFECT, HEALED; LOCAL DEGRADATION
			79	E2	5	150	HOLE DEFECT, HEALED
			80	E3	5	150	HOLE DEFECT, HEALED
			91	G1	5	150	REMOVAL DEFECT, HEALED; LOCAL DEGRADATION
			92	G2	5	150	REMOVAL DEFECT, HEALED
			93	G3	5	150	REMOVAL DEFECT, HEALED
1954	10	2	84	I1	5	150	NOTCH DEFECT, NO CHANGE; LOCAL DEGRADATION
			85	I2	5	150	NOTCH DEFECT, NO CHANGE
			86	I3	5	150	
			87	K1	5	150	IMPRESSION DEFECT, NO CHANGE
			88	K2	5	150	
			89	K3	5	150	
1955	10	2	90	D1	1	30	HOLE DEFECT, NO CHANGE
			91	D2	1	30	
			92	D3	1	30	
			93	F1	1	30	REMOVAL DEFECT, NO CHANGE
			94	F2	1	30	
			95	F3	1	30	
1956	10	2	96	H1	1	30	NOTCH DEFECT, NO CHANGE
			97	H2	1	30	
			98	H3	1	30	
			99	J1	1	30	IMPRESSION DEFECT, NO CHANGE
			100	J2	1	30	
			101	J3	1	30	
1957	10	2	102	L1	1	30	
			103	L2	1	30	
			104	L3	1	30	
			14	COATED Ta 60° [illegible]5	8	240	NO CHANGE
			13	[illegible]4	8	240	NO CHANGE
1960	12	2	109	D4	1	30	HOLE DEFECT SIGNIFICANT GROWTH

TABLE 4 TEST SAMPLE PERFORMANCE SUMMARY (Continued)
METALLICS

Test	Test Condition	Model	Sample	Sample Description	End Cycle	Total Exposure Time (min)	Sample Response and Performance Characteristics
1960	12	2	110	COATED Ta 60° D5	1	30	HOLE DEFECT; SIGNIFICANT GROWTH
			113	F4	1	30	REMOVAL DEFECT; SIGNIFICANT GROWTH
			114	F5	1	30	REMOVAL DEFECT; NO CHANGE
			117	H4	1	30	NOTCH DEFECT; SMALL GROWTH
			118	H5	1	30	NOTCH DEFECT; NO CHANGE
1961	12	2	121	J4	1	30	IMPRESSION DEFECT, SIGNIFICANT GROWTH
			122	J5	1	30	IMPRESSION DEFECT; GROWTH
			125	L4	1	30	IMPRESSION DEFECT, HEALED;
			126	L5	1	30	IMPRESSION DEFECT, NO CHANGE
1964	12	2	111	E4	3	90	HOLE DEFECT; GROSS GROWTH
1962	12	2	112	E5	1	30	HOLE DEFECT; NO CHANGE
1964	12	2	115	G4	3	90	REMOVAL DEFECT; GROSS GROWTH
1962	12	2	116	G5	1	30	REMOVAL DEFECT; NO CHANGE
1964	12	2	119	I4	3	90	NOTCH DEFECT; GROSS GROWTH
1966	12	2	120	I5	5	150	NOTCH DEFECT; NO CHANGE
1964	12	2	123	K4	2	60	IMPRESSION DEFECT; SIGNIFICANT GROWTH
1966	12	2	124	K5	4	120	IMPRESSION DEFECT; SIGNIFICANT GROWTH
1969	12	2	105	A4	5	133	NO CHANGE
1966	12	2	106	A5	2	60	GROSS FAILURE AT CYCLE 2
1969	12	2	107	B4	5	133	NO CHANGE
1969	12	2	108	B5	5	133	GROSS FAILURE AT CYCLE 5

TABLE 4 TEST SAMPLE PERFORMANCE SUMMARY (Continued)
SURFACE INSULATORS

Test	Test Condition	Model	Sample	Sample Description	End Cycle	Total Exposure Time (min)	Sample Response and Performance Characteristics
1977	9	2	136	HCF 180° 6-1	30	900	NO CHANGE
1970	10	"	139	LI-1500 180° 6-1	6	180	MELT AROUND ID
1977	9	4	135	SiC FOAM 180° 8-24	30	900	SMALL RADIAL SURFACE CRACKS
"	"	"	142	LI-1500 180° 6-1	"	"	COATING CRACKS AND DELAMINATION BETWEEN CYCLES 6-12
1972	10	2	137	HCF 180° 6-1	5	125	WATER DAMAGE
1971	12	"	140	LI-1500 180° 6-1	1	24	GROSS MELTING
1972	10	"	143	"	4	95	WATER DAMAGE
1977	9	"	144	"	24	720	COATING CRACKS & DELAMINATION BETWEEN CYCLES 18-24
1974	10	"	127	LI-1500G 180° 11-18	4	95	NO CHANGE
"	"	"	128	"	"	"	LOCAL COATING LOSS
1979	"	4	129	LI-1500 180° 11-18	17	510	SMALL RADIAL SURFACE CRACKS
"	"	"	130	LI-1500B 180° 11-18	"	"	NO CHANGE
"	"	2	145	HCF 180° 6-1	12	360	NO CHANGE
"	"	"	146	LI-1500 180° 6-1	"	"	MELT AROUND ID, COATING CRACKS
1982	"	"	147	HCF 150° 12-21	18	540	CRACKS BETWEEN CYCLES 6-12, DELAMINATION BETWEEN 12-18
"	"	"	148	"	"	"	CRACKS BETWEEN CYCLES 12-18
1981	"	4	149	"	12	360	CRACKS BETWEEN CYCLES 0-6, DELAMINATION BETWEEN 6-12
"	"	"	150	"	"	"	CRACKS & DELAMINATION BETWEEN CYCLES 6-12
1983	"	"	151	"	6	180	NO CHANGE
"	"	"	152	"	"	"	CRACKS & DELAMINATION BETWEEN CYCLES 0-6
1987	"	2	153	REI 120° 12-9	30	900	NO CHANGE
"	"	"	154	HCF 120° 12-9	"	"	NO CHANGE
"	"	"	155	LI-1500G 120° 12-9	"	"	NO CHANGE
"	9	4	156	REI 120° 12-9	"	"	NO CHANGE
"	"	"	157	HCF 120° 12-9	"	"	NO CHANGE
"	"	"	158	LI-1500G 120° 12-9	"	"	NO CHANGE
1991	13	2	138	HCF 180° 6-1	"	"	SURFACE CRACKS BETWEEN CYCLES 0-6
"	"	"	141	LI-1500 180° 6-1	"	"	SURFACE CRACKS & DELAMINATION BETWEEN CYCLES 12-18
"	"	4	133	SiC FOAM 180°	"	"	SURFACE CRACKS BETWEEN CYCLES 6-12
"	"	"	134	"	"	"	SURFACE CRACKS BETWEEN CYCLES 0-6, DELAMINATION 24-30

TABLE 4 TEST SAMPLE PERFORMANCE SUMMARY (Continued
CARBON-CARBON COMPOSITES

Test	Test Condition	Model	Sample	Sample Description	End Cycle	Total Exposure Time (min)	Sample Response and Performance Characteristics
1998	12	2	169	PF-B-1 180°	5	150	PITTED SURFACE
		1	170	PF-B-2 180°	5	150	SURFACE PARTIALLY LOST, INTERNAL STRUCTURE EXPOSED
		4	167	E4A-3-1 180°	4	120	SURFACE UNCHANGED EXCEPT LOCAL FAILURE AT PERIPHERY
		1	168	E4A-3-2 180°	4	120	NO APPARENT CHANGE
2000	11	2	47	PF-D-1 180°	12	360	LOCAL PITTING IN CENTRAL AREA
2003		1	48	PF-D-2 180°	30	900	LOCAL PITTING AFTER 12 CYCLES
2001		4	55	E4A-4-1 180°	17	484	MAJOR LOSS OF SURFACE AND STRUCTURE
2001		1	51	E4A-2-1 180°	17	484	MAJOR LOSS OF SURFACE AND STRUCTURE
2002		2	45	PF-C-1 180°	12	360	SURFACE CRACKS AT 6 CYCLES, LOCAL SURFACE LOSS AT 12 CYCLES
2003		4	46	PF-C-2 180°	12	360	SURFACE CRACKS AT 6 CYCLES
		1	56	E4A-4-2 180°	12	360	SURFACE UNCHANGED, SOME SUBSURFACE LOSS
		2	49	E4A-1-1 180°	6	180	SURFACE UNCHANGED
2006		1	37	C4A-1 360°	6	180	SURFACE UNCHANGED EXCEPT LOCAL LOSS, LOCAL STRUCTURE FAILURE
2004		4	172	DA 0.5 60°	1	18	SURFACE LOSS AND HOLE
2006			62	EMJ-1 60°	3	75	NO APPARENT CHANGE
2005			174	E-1 60°	2	45	LOCAL COATING LOSS
			175	DIH-5 60°	2	45	LARGE CENTRAL HOLE
2004			176	DIA 1.5-1 60°	1	18	SIGNIFICANT SURFACE LOSS
			177	DA 1.5 60°	1	18	SURFACE LOSS AND LOCAL HOLE
2006			180	E2 60°	2	57	LOCAL SURFACE LOSS
			178	4H7 60°	2	57	LARGE CENTRAL HOLE
			179	5H8 60°	2	57	SAME, BUT SIGNIFICANT SURFACE LOSS
			58	DH-1 60°	1	30	LOCAL COATING LOSS
			59	DH-3 60°	1	30	NO SIGNIFICANT CHANGE
2008		2	39	C4A-3 360°	12	360	NO APPARENT SURFACE CHANGE, SOME SUBSURFACE LOSS
2009			40	E4A-5 360°	2	40	LOCAL SURFACE LOSS, SOME SUBSURFACE LOSS
2010			38	C4A-2 360°	4	120	LOCAL SURFACE LOSS, SIGNIFICANT SUBSURFACE LOSS

TABLE 4 TEST SAMPLE PERFORMANCE SUMMARY (Concluded)
ABLATORS

Test	Test Condition	Model	Sample	Sample Description	End Cycle	Total Exposure Time (min)	Sample Response and Performance Characteristics
2011	10	2	159	SS-41 HC 360°	1	16.67	
1		4	160	SS-41 HC 360°		33.33	
2012		2	163	SS-41 360°		16.67	
1		4	164	SS-41 360°		33.33	
2013	12	2	165	SS-41 360°		16.67	LOCAL LOSS AT HONEYCOMB
1		4	166	SS-41 360°		33.33	LOCAL LOSS AT HONEYCOMB
2014		2	161	SS-41 HC 360°		16.67	LOCAL LOSS AT HONEYCOMB
1		4	162	SS-41 HC 360°		33.33	LOCAL LOSS AT HONEYCOMB

TABLE 5 TEST SAMPLE SURFACE CATALYCITY RESULTS
TEST CONDITIONS

Test	Test Condition	Model	Sample	Sample Description	Cycle	Current (Amps)	Centerline Total Enthalpy HF (Btu/lb)	Average Total Enthalpy EB (Btu/lb)	Average Total Enthalpy MB (Btu/lb)	Chamber Pressure (atm)	Air Flow Rate (lb/sec)	Heat Flux Calibration Model (Btu/ft²sec)	Heat Flux Center Post (Btu/ft²sec)	Center Post Stagnation Pressure (atm)	Comments
1980	9	2	147+148	HCF 180° 12-21	1	355	6880	3720	3960	.188	.0107	28.5 355	25.9	.0066	
	10					393	9780	4190	4910	.157	.0082	—	33.3	.0062	
						441	10,880	4750	5410	.163			37.4	.0066	
						489	12,090	5250	5800	.167			40.6	.0069	
						541	13,380	5620	6240	.172			48.5	.0072	
1980	9	4	149+150	HCF 180° 12-21	2	353	6850	3570	3930	.187	.0107	27.1 350	(22.3)	.0066	
	10					391	9760	4080	4800	.156	.0082	—	(29.8)	.0062	
						433	10,800	4710	5290	.161			(35.0)	.0066	
						470	12,110	4780	5700	.167			(39.7)	.0069	
						542	13,400	5100	6220	.172			(41.3)	.0075	

TABLE 5 TEST SAMPLE SURFACE CATALYCITY RESULTS (Concluded)
SAMPLE RESPONSE

Test	Test Condition	Model	Sample	Sample Description	Cycle	Cold Wall Heat Flux (Btu/ft²sec)	Hot Wall Heat Flux (Btu/ft²sec)	Stagnation Pressure (atm)	Total Enthalpy (Btu/lb)	Heat Transfer Coefficient (lb/ft²sec)	Surface Temperature Value (°F)		Surface Temperature Assumed Emissivity (-)	Radiation Equilibrium Surface Temperature for q_{re} (°F)	Radiation Equilibrium Heat Flux for T_w (Btu/ft²sec)	Heat Flux Ratio q_{re}/q_{hw}		Comments
1980	9	2	147	HCF 80° 12-21	1	25.9	24.19	.0066	6980	.0038	2010		.75	2911	13.3	.55		PY-T 1655 °F
			148								2010				13.3	.55		PYB 2100 °F
	10	2	147			33.3	31.44	.0062	9780	.0034	2090			2614	15.1	.48		PY-T 1750 °F
			148								2070				14.6	.46		PY-B 2180 °F
			147			37.4	35.09	.0066	10,880	.0034	2190			2691	17.6	.50		PY-T 1847 °F
			148								2160				16.8	.48		PYB 2290 °F
			147			40.6	31.10	.0061	12,090	.0034	2270			2760	19.8	.51		PY-T 1952 °F
			148								2270				19.8	.51		PY-B 2390 °F
			147			48.5	45.95	.0072	13,380	.0036	2350			2915	22.3	.48		PY-T 2035 °F
			148								2350				22.3	.48		PYB 2480 °F
1980	9	4	149	HCF 180° 12-21	2	(22.3)	—	.0066	6850	—	2060		.75	—	14.4	—		PY-T 1750 °F
			150								2080				14.9			PYB 2140 °F
	10	4	149			(29.8)		.0062	9760		2150				16.6			PY-T 1839 °F
			150								2160				16.8			PYB 2230 °F
			149			(35.0)		.0066	10,800		2230				18.7			PY-T 1901 °F
			150								2240				19.0			PYB 2310 °F
			149			(39.7)		.0061	12,110		2290				20.4			PY-T 1980 °F
			150								2310				21.0			PYB 2390 °F
			149			(41.3)		.0073	13,400		2360				22.6			PY-T 2045 °F
			150								2370				22.9			PYB 2460 °F